POPULAR SCIENCE

MONTHLY

NOVEMBER

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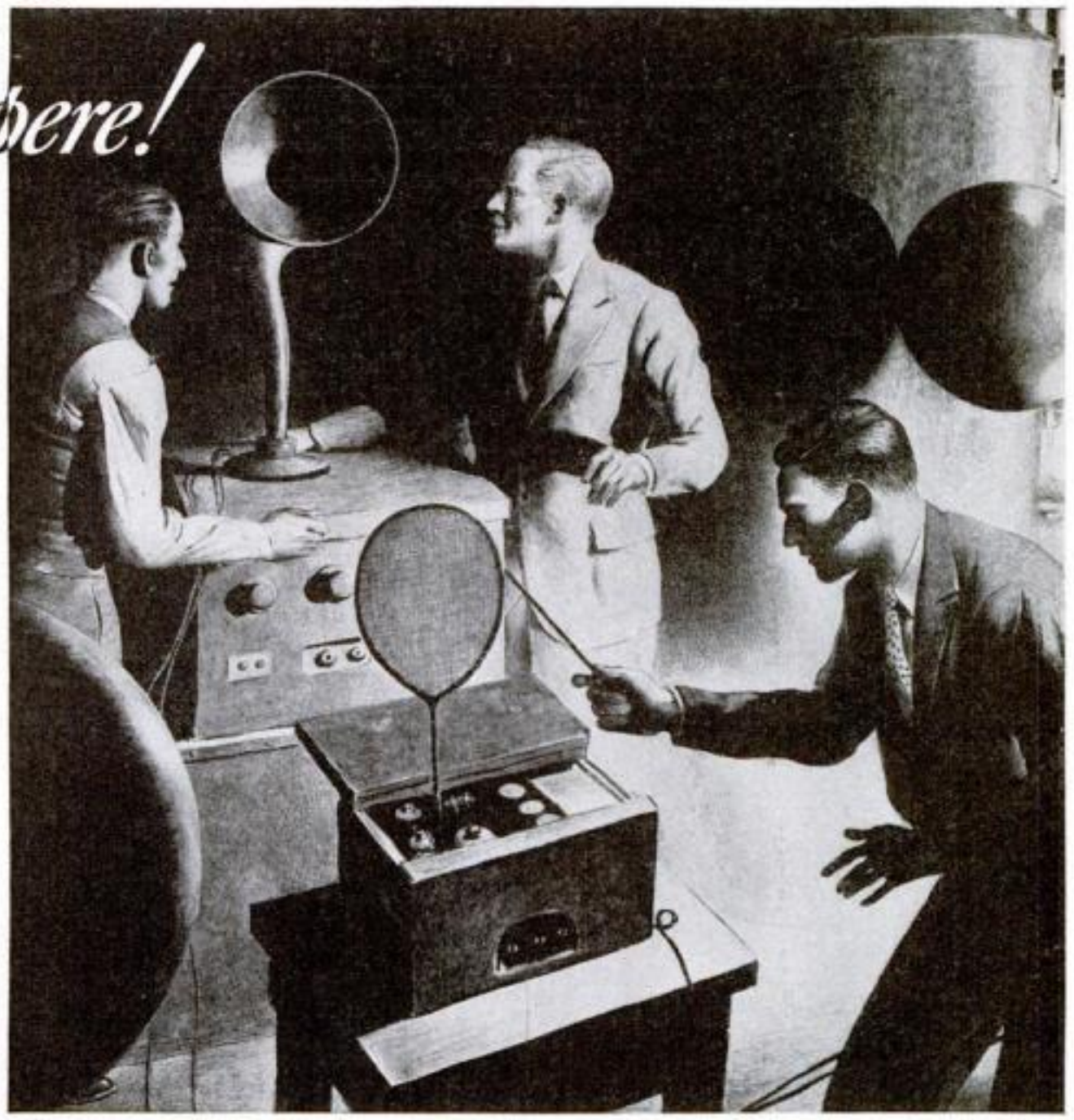

TRAPPING AN ATOM...in the General Electric "House of Magic." Just one of the many strange quests, conducted by G-E scientists, in the search for new and valuable knowledge. Here, too, elusive sounds are captured and measured—sounds that neither human voice nor musical instrument can produce. And the secrets thus disclosed were used in the making of a finer, more sensitive speaker that distinguishes the 1936 General Electric Radio.

AND OUT OF THE "HOUSE OF MAGIC" CAME A NEW RADIO MIRACLE

IN this new General Electric Radio you'll discover many surprising things.

You will find that glass radio tubes have been replaced by tubes of steel . . . by new metal tubes* that have eliminated "shielding cans" and the "crackles" caused by them when they become loose . . . subdued the microphonic twang that clouds reception.

Purity of tone jealously guarded

Allied with these enduring metal tubes is a Stabilized Speaker . . . born in rooms so silent that the rustling of paper sounds like the beating of African war drums.

A supremely sensitive speaker that reproduces speech and music with life-like brilliance.

And this purity of tone is jealously protected by the Permaliner that maintains the original alignment of the radio . . . keeping the set at "concert pitch" over a long and glorious career.

Halt! And a thousand radio waves obey

Look still further, and you'll discover yet another "House of Magic" wonder-worker. It's the Sentry Box, controlling as many as five separate broadcasting bands . . . housing a sentinel that puts the fabled labors of Hercules to shame.

A thousand and one radio waves, traveling at a speed of 186,000 miles a second, assail him . . . demand entrance of him. But only one wave is permitted to pass — the wave you're dialed to hear.

As easy to read as a ruler

While admiring the styling of the new G-E Radio, you can't help but be impressed by the Sliding-rule Tuning Scale which shows only one tuning band at a time . . . lists all stations in a straight line.

Yes—you're going to get a thrill from this "House of Magic" radio the first time you turn its ocean-spanning dials.

And that thrill is going to last—for this receiver has a brilliance of performance that the years cannot dull.

It is now on display at your nearest G-E Radio Dealer's. In a handsome variety of consoles and table models—priced from $34.50 up. (Prices slightly higher in the West, Mid-West and South, and subject to change without notice.)

Use the new General Electric V-Doublet Antenna for best short-wave reception.

**Metal radio tubes, invented and perfected by General Electric, are made for General Electric by the RCA Mfg. Co. Complete receivers manufactured by General Electric at Bridgeport, Conn.*

Travel to distant countries on these "magic carpets" . . . priced as low as $34.50.

Model A-57 — Eight-tube, 4-band superheterodyne, completely equipped with metal tubes. Walnut cabinet of neo-classic design.

The new 1936 GENERAL ELECTRIC RADIO

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FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

"THIS NEW MOBILOIL IS THE FINEST OIL WE'VE EVER SOLD"

FALL DRIVING'S FUN with this new Mobiloil! It gets the most out of your engine...protects it at all speeds...helps keep it clean...cuts down on repair costs...saves money all around!

GET SET for the fall season with an engine that runs smoothly and economically. Drive in today and have your crankcase filled with the new Mobiloil...you'll find it different from any oil you've ever used before!

Mobiloil dealers are calling this new Mobiloil the finest motor oil they've ever sold. They're sincere about this, because they know how well Mobiloil protects engines. They know how it stays on the job...safeguards your motor at all operating speeds...and keeps repair bills down!

Mobiloil gives this different performance because it's *made* differently. The Clearosol Process cleanses it of impurities that have heretofore defied all refining methods...hence it is cleaner ...and helps keep your engine cleaner.

Be sure to get this new Mobiloil, the world's largest-selling motor oil, today —wherever you see the Sign of the Red Gargoyle or the Flying Red Horse.

This new Mobiloil is made in the correct grades for all makes of cars and for every season: Mobiloil Arctic, A, AF, BB, and B. See your Mobiloil dealer today—for a safe, sweet-running engine.

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Mobiloil

SOCONY-VACUUM GARGOYLE Mobiloil

SOLD AT THE SIGN OF THE RED GARGOYLE OR THE FLYING RED HORSE

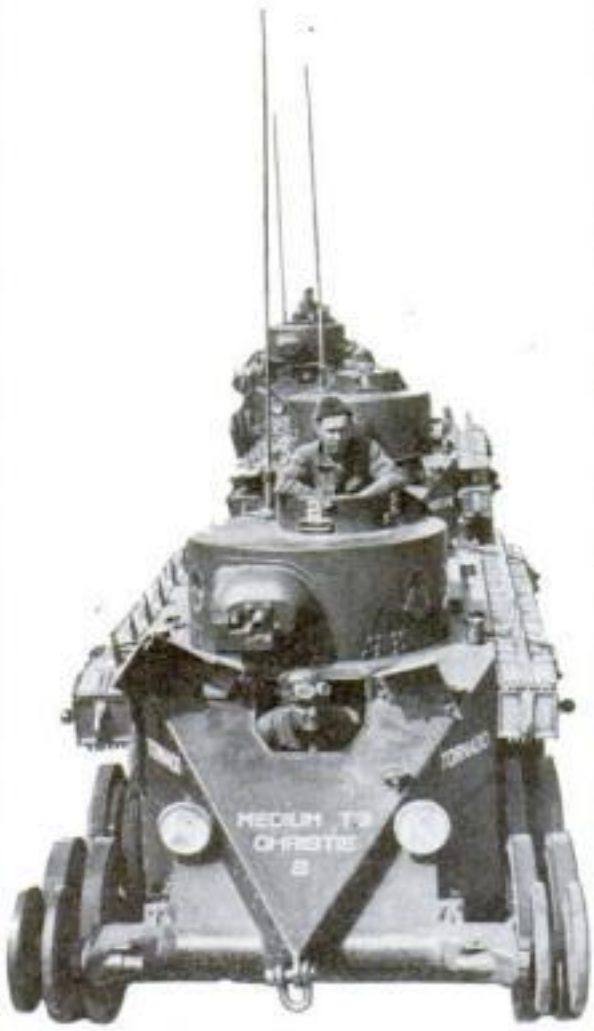
POPULAR SCIENCE MONTHLY FOR NOVEMBER, 1935

MODELS

NEW DEVICES FOR THE HOME

NEW PROCESSES AND INVENTIONS

UNUSUAL FACTS AND IDEAS



MODERN U. S. Army tanks running on wheels with their tractor treads ready for use. Read about these land battleships in an article on page 25.

CRAFTWORK

WOODWORKING

IDEAS FOR THE HANDY MAN

There are 270,000 workers in the Bell System. The 100,000 telephone operators are able to serve you as they do because of the specialized ability of 170,000 other employees—installers, linemen, repairmen, construction crews, engineers, commercial office workers and the many thousands engaged in research, manufacture and management.

SWIFT, SKILLED, COURTEOUS SERVICE

SHE is one of 100,000 operators in the Bell System—local operators, special operators for the dial system, toll operators, information operators and many others—all specialists in giving you efficient telephone service.

The alert, friendly voice of the operator is familiar to all who use the telephone. Through the years it has come to mean more than a voice. It is the symbol of politeness and efficiency.

The manner of this service is as important as the method. Even a few words can reflect a business-like, courteous attitude.

The operators in the Bell System are carefully trained. But there is something more to it than training—a spirit of loyalty and of pride in rendering an important service. This spirit is ever-present—it has brought especially high commendation in time of emergency.

Truly the telephone operators have been called "Weavers of Speech." Their swift, skilled fingers intertwine the voices and activities of communities and continents. For daily, as upon a magic loom, the world is bound together by telephone.

BELL TELEPHONE SYSTEM

Build a Ship Model FOR CHRISTMAS

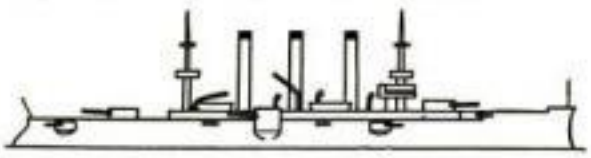
KIT Z—Materials for H.M.S. *Bounty*

SHIP models are always highly appreciated as Christmas presents. You can therefore solve at least one of your gift problems by making a model, if you enjoy that type of work. We have a large variety of construction kits for miniature ships, and blueprints for a great many more (see page 80).

Select the model according to the time you can give the work and the person for whom it is intended. The simplest of our models, and those which require the least time to make, are listed under the heading "Model-of-the-Month Kits." The *Bounty* and the illuminated show boat are excellent gifts for either men or women; the various warships appeal to men and boys; and the little *Hispaniola*, which can be made in a few hours, is a fine gift for any child who has read *Treasure Island*.

The models listed under the heading "Simplified Ship Model Kits" take only a little longer to make. The *Sea Witch*, a picturesque clipper ship, appeals to both men and women, and the *Manhattan* and *Indianapolis* to men and boys.

The standard kits are larger and require considerable time to work up into models, but they are, of course, correspondingly valuable.



KIT T—U. S. S. *Brooklyn*

The Spanish galleon, the Elizabethan galleon, the *Constitution*, and the *Sovereign of the Seas* are splendid gifts for either men or women; the others may perhaps have a slightly greater appeal for men, although they are all highly decorative.

Note also that several furniture kits are available, and one especially ingenious whittling kit.

STANDARD SHIP MODEL KITS

A. Whaling Ship *Wanderer*, 20½-in.....$6.90*
AA. With hull lifts sawed..... 7.40*
D. Spanish galleon, 24-in..... 6.45*
DD. Same with hull blocks shaped.... 6.95*
E. Battleship U.S.S. *Texas*, 3-ft..... 6.95*
EE. Same with hull lifts sawed..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 6.75*
GG. Same with hull blocks shaped.... 7.25*
L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war, 33½-in. hull..... 7.95*
LL. Same with hull lifts sawed..... 8.45*
Q. Privateer *Swallow*, 12½-in. hull, with lifts sawed to shape..... 4.95†
V. Clipper *Sovereign of the Seas*, 20½-in. hull, with lifts sawed to shape..... 4.95†
Y. Trading schooner, 17½-in. hull..... 4.90†
2S. U. S. Destroyer *Preston*, 31½-in. hull, with lifts sawed..... 5.95*
3S. *Constitution* ("Old Ironsides"), 21-in. hull, with lifts sawed..... 6.50*

(Continued on following page)

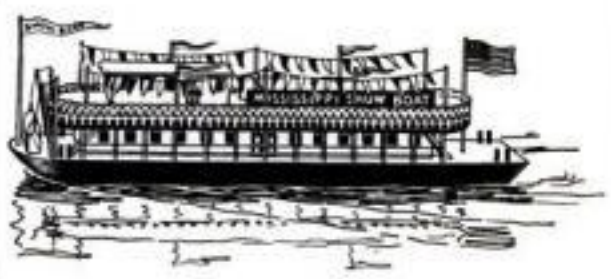
KIT V

SIMPLIFIED SHIP MODEL KITS

F. Liner S.S. *Manhattan*, 12-in..... 1.00
H. Cruiser U.S.S. *Indianapolis*, 12-in. 1.50
J. Clipper ship *Sea Witch*, 13-in..... 1.50

MODEL-OF-THE-MONTH KITS

M. Aircraft carrier *Saratoga*, 18-in..... 1.00
N. Four U.S. destroyers, each 6¼-in. .75
O. Liner S.S. *St. Louis*, 11-in..... 1.00
R. U. S. cruiser *Tuscaloosa*, 11¾-in... 1.00
T. U.S.S. *Brooklyn*, armored cruiser in Spanish American War, 8-in..... .75
U. *Hispaniola*, the ship in "Treasure Island," 7-in..... .50
Z. H.M.S. *Bounty*, 11½-in..... 1.50



KIT 1M—An illuminated show-boat model

1M. Show boat, illuminated, 14-in..... 1.50
2M. Ocean freighter, 14-in..... 1.50

MISCELLANEOUS

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble and stain included 5.75*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included..... 5.75*

No. 6. Solid rock maple butterfly table, top 19 to 22 in., height 22½ in. Ready to assemble and stain included..... 6.90*

No. 7. Whittling kit with two shaped blocks for making sea captain 5½ in. high..... 1.50

NOTE: If you live west of the Mississippi River or in Canada, add 50 cents to all prices marked with an asterisk (*) and 25 cents to all prices marked with a dagger (†). Otherwise all prices are postpaid anywhere in the United States or Canada. The kits marked with an asterisk or dagger will be sent C.O.D. in the United States upon request, but the purchaser will have to pay 25 cents additional.

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Please send me Kit.....for
which I inclose $.....(or send C. O. D. ☐)

Name.....

Address.....

City.....State.....
(Print name very clearly.)

Remit by money order, check, or registered mail. No kits selling for less than $4.00 can be sent C. O. D. This offer is made only in the United States and Canada.

NEW TOOLS AND MATERIALS FOR

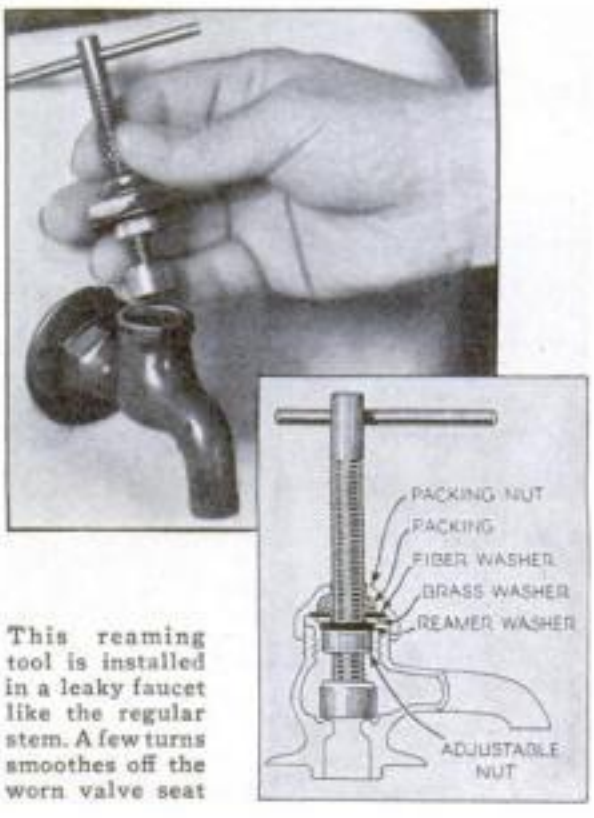
Home Building *and* Repair

A workman laying a floor of the new fireproof gypsum material. The reënforced planks are bound with galvanized steel and are tongued and grooved like any ordinary boards

REËNFORCED "planks" of gypsum form the latest material for the construction of fireproof floors and roofs. Bound on the edges with galvanized steel, and tongued and grooved like ordinary boarding, they can be laid easily over either wood or steel joists or beams. The material can be cut, nailed, or bored with ordinary tools and can be fastened in place to beams and joists with metal clips. Sold in several widths and two thicknesses, the planks can be laid in standard lengths regardless of the location of supports, minimizing cutting and waste. Besides being durable and fireproof, the material also is a heat insulator. The gypsum used is a laboratory-controlled product of extra hardness and density.

REAMING TOOL RENEWS WORN WATER FAUCETS

WHEN a water faucet leaks, it is not always a sign that the washer needs replacing. It may mean that the valve seat is so worn, or so encrusted with scale, that the washer cannot make a tight fit. As a remedy for this trouble, the inexpensive faucet reamer shown at the left has recently been placed on the market. Installed in a compression-type faucet in place of the regular stem and given a few turns, its cutter head smooths the worn valve seat and insures a flat bearing surface for the new washer. No downward hand pressure is needed during the reaming process; an adjusting nut and the threaded shank provide an automatic feed. A single reamer will serve the needs of the entire home, as the one size in which it is offered is designed to fit ninety percent of the compression-type faucets in common use.



This reaming tool is installed in a leaky faucet like the regular stem. A few turns smoothes off the worn valve seat

NEW TILTING WINDOW IS EASY TO CLEAN

BY MEANS of a new system of hanging, windows now can be altered so that they can be pulled completely inside the room to allow easy cleaning and repair. The necessary hardware and fittings, sold in kit form, can be applied to any double-hung window by any one handy with a saw and hammer. In winter, they allow the outsides of the windows to be cleaned from the inside as shown below and their special, tight-fitting construction makes them draft- and weather-proof when in place. Similarly, they provide any degree of ventilation in summer. According to the designer, the conversion cost is little more than that of a weatherstripping job.

Questions
FROM HOME OWNERS

Q.—How can I test for a leakage of sewer gas?—T.O.F., Chicago, Ill.

A.—MAKE up a special test paper by soaking a piece of soft paper towel in a solution made by dissolving one ounce of pure lead acetate in one half pint of distilled water. The paper will turn black in the presence of sewer gas.

Firing a Furnace with Coke

G. D., WHITE PLAINS, N. Y. When using coke or soft coal, do not cover the entire coal surface with fresh fuel. Put the new coal on in front, leaving the glowing coals visible at the rear.

Weathering New Shingles

P. C. S., RICHMOND, VA. When new shingles are used to patch a roof, they should be given an artificial weathered appearance so that they will match the old shingles. This can be done by applying a thin stain consisting of half linseed oil and half turpentine and enough dry color such as burnt umber or lampblack to give the desired tint. Asphaltum thinned with turpentine also will serve.

Our Readers Say

Wants Her Dishes To Vanish After Each Meal

In last month's issue of your magazine, I read about an electric grinder that had been perfected to replace the garbage can. Everything from watermelon rind to soup bones, says this item, is reduced to such a fine pulp that it can be washed down the drain without clogging the pipes. This will certainly be a boon to us women who must do our own kitchen drudgery. With such a device installed in my kitchen, I would ask for only one more innovation—a substitute for our conventional dishes which must be washed and dried three times every day. I know there are paper dishes on the market but these are in such a form that their use is, to say the least, unappetizing. Why can't a dish be made from an inexpensive, nonabsorbent material that can be fashioned into a pleasing form? If these were available, then after each meal they could be disposed of via the electric grinder—I hope to get. Yes, you've guessed it. I hate to wash dishes.—Mrs. C.M. L., Newark, N. J.

Spinning Shaft Leaves Him In Bit of a Whirl

Will you publish this letter in your magazine so that I may get an explanation from some of the readers as to why the absolute center of a spinning shaft must stand still? I have had numerous arguments on this subject and somehow I am unable to convince many that such is the case. In fact, I can hardly perceive the phenomenon myself but know it must be so. What proof will some reader offer?—W.G. Van N., Jackson, Mich.

Here's One Thing That Goes to Pieces on a Soft Job

Here is a question I would like to ask the readers of Popular Science Monthly. Bullets have a queer way of behaving. Use a high-speed, lightweight bullet, such as the .250 Savage, to shoot a small animal weighing about twenty pounds and the bullet will go to pieces—and so will the animal. Shoot that same type bullet at a steel plate and it will not go to pieces. If the plate is not too thick, it will penetrate it, leaving a neat hole, and travel on. Fire the same type bullet at the lean, hard shoulder of a lion and, it is reported, the soft point of the missle will penetrate about as far as the full jacket. Shoot a deer in the soft abdominal area and no part of the missile as large as a No. 2 shot will be found. Will somebody tell me why a rifle bullet explodes and flies to flinders upon striking soft substances but remains intact when encountering harder substances?—J.F. N., Wilkes-Barre, Pa.

Window-Crashing Bird Fights Its Own Image, Says Reader

The fighting of a robin with its own image in the window, mentioned in the Our Readers Say of a recent issue, is explained by the "territory in bird life" theory. That is, a bird takes possession of a small territory around its nest before and during the breeding season and keeps out all intruders. An interesting example in support of this theory, recently heard by the writer, concerned a catbird. The bird, having a nest in a garden, would strive to drive away its own image present in the window of the house located on the same grounds. But its own image reflected in a glass just over an inclosing wall would not excite it. The latter, presumably, was out of its territory.—B.J.B., Chicago, Ill.

What Will the Children Use For Swimming Floats?

Many items which we use daily have been progressively improved in efficiency and design but these improvements are usually made without changing the medium. For example, take the automobile tire. A better and longer-lived pneumatic tire has been the result of years of research. But why concentrate, as apparently has been the case, on pneumatic tires? Why not try some new wrinkle—something unconventional? What I have in mind is a permanent frame to fit on the wheel of an automobile. This frame would be adequately equipped with shock-absorbing devices. The outer surface of the frame would be covered by a replaceable tread, rubber or another substance. The tread should be such that it can be produced cheaply, has good resilient properties, and is serviceable for 3,000 or 4,000 miles. With such a tread and arrangement on the market (the tread selling for about $2, for the smaller sizes), an autoist could afford to buy three or four sets of treads a year and would save money in so doing. Sort of like stopping in the shoemaker's to get a new pair of rubber heels. Maybe there's a catch somewhere in this idea but I can't forsee any real obstacle. I would like to know what some of your inventive auto owners think of this suggestion.—A.B.O., Flint, Mich.

Perhaps You Need Mirrors To Do This One

A friend of mine states that it is possible to take any prime number, use it three times in the correct mathematical calculation, and the result will always equal twenty-four. The appearance of the number in the equation constitutes its use, such as, $22+2=24$ or $3^3-3=24$. My friend declines to show me his solutions but assures me that he has worked such problems with all the prime numbers up to and including 19. Maybe some of the mathematical sharks among the Readers Say fans can tell me whether I'm being taken for a mathematical sleigh ride or if the numerical calculations can actually be worked out to give the answer 24 each time?—E.J.L., Grand Rapids, Mich.

For a Whittling Diet, He'll Take Frogs

Your whittled model is a fine idea. Why not more of it—some real model carving? How about some real, lifelike patterns of frogs in different sizes, kinds, and positions? A frog is an all-in-one-piece job of whittling, can be carried around in your pocket, and can be worked on when you feel like it. You can sit outdoors and need not be cooped up in a shop. If the model is made so that it may be used as a pattern (will draw out of the sand), the frogs may be cast in metal. When painted in natural frog colors, they are not only ornamental but useful as doorstops, book ends, paper weights, and many other household articles. A big bullfrog, sitting with his mouth open, makes a novel ash tray or cigarette stand.—R.S.W., Elverson, Pa.

Giant Radio Tower Causes Rift In Overhead Clouds

A friend of mine lives about twenty miles east of the 831-foot vertical antenna of radio station WLW. He has noticed that since the erection of this tower all low-moving clouds seem to split while over the structure and then join together again when they get nearer his point of observation. What is the answer to this phenomenon? We have heard that rain clouds are supposed to carry an electrical charge and we are wondering if the clouds could be repelled by the electrical charge from the towering antenna.—B.H., Blanchester, Ohio.

Hails Skunk as Inventor Of Chemical Warfare

According to the newspapers, the Ethiopians are planning to draft civet cats for active military service. These formidable creatures, which have a defensive strategy resembling that of our own skunk, will garrison water holes and lay down barrages to annoy thirsty invaders. It seems that nature was the first inventor in the field of warfare; all our boasted "modern weapons" have their counterparts among fishes, birds, and animals. Camouflage was brought to perfection by the chameleon; the squid was using a smoke screen when humans thought the trireme was the last word in naval warfare; the turtle and the armadillo blazed the trail for the tank. As for chemical war-

fare, look at the skunk—through field glasses. It's a wonder the Indians weren't smart enough to conscript the woods-pussy. If they had, the Pilgrims would not have lingered long on Plymouth Rock but would have made a hasty retreat to the *Mayflower* and left this country in the hands of the 100-percent Americans.—I.J., Knoxville, Tenn.

Sees New Power Age as Waiting Until New Fuel Arrives

THE article, "Diesel Engines Usher in New Age of Power," was a timely one but I do not think that it shows how the Diesel is going to play its coming role of power king. As long as it must use oil for fuel, it cannot circumvent the obstacle of high fuel costs any more than the gasoline engine can. I believe most readers will agree with me that in the event of the general adoption of Diesel engines, the cost of fuel oil will rise in proportion to the demand. While this factor was mentioned in your article, it was, I believe, underemphasized. Therefore it is my belief that the factor which will usher in a new power age will be a cheaply produced fuel from a limitless vegetable source such as cellulose. When such a fuel is developed, I am confident an engine will be perfected to utilize it efficiently and inaugurate a new age of power.—S.T.Y., Rochester, N. Y.

When Is a Surface Not a Surface, He Asks

CAN some one point out a way for me to get a clear conception of the geometrical dimensionless point, line and plane. Any point I can imagine is a volume, no matter how small. Any line is a "row" of these small volumes excepting only the paths of motion which I can mentally picture. I can imagine no plane whatsoever detached from volume. Length, breadth and thickness seem like unreal measures because, to me, if they are not all there together, there isn't anything there. I understand what the geometrical and algebraic formulae and calculations are driving at but find it impossible to imagine (in the application of these first geometrical concepts to the actual material world) length and breadth without any thickness, for example. A surface is very real and actual but never a surface by itself. When I conceive of any surface, I perceive a volume or solid of which it is always a part. Remove either the length or breadth or thickness and there is nothing left.—W.J.L., Hartford, Conn.

Urges Gus To Consider The Fellow With a Motor Cycle

AS A reader of your magazine, I am, on the whole, very well satisfied. Though there are a number of things I have little use for, I like to look at them and I figure that they are just what some other fellow is looking for. I am particularly interested in the monthly article about Gus Wilson and his Model Garage, and also the woodworking and craftwork projects. I want to make a request that you persuade Gus to write an article about the upkeep of motor cycles and their ailments and cures. This may appear to be a peculiar request but I am sure there are numerous motor-cycle riders among your readers who would appreciate such an article.—H.H., Agua Dulce, Texas.

Seeks Enlarger That Reduces His Pocketbook but Little

MR. RYDER'S articles on photography, I think, are A-1. I have been hoping that he would write an article telling how to build a simple enlarger—say something to hitch onto a roll-film or film-pack camera. I have found that the prices of most enlargers run high when the buyer is just going to use one for his own work with no intention of becoming a professional. Perhaps some of your photo-fan readers have solved this problem and would pass their solution along to the rest of us?—P.B.M., Marionville, Mo.

Says R. H. to R. H. You're Wrong About Evolution

I WISH to voice my disagreement with the letter of R.H., Edgewood, Pa., in Our Readers Say of a recent issue. R.H. suggests radioactivity as an evidence of evolution but radioactive elements are being broken down into base metals (finally lead) at a much faster rate than they are being produced. This is a process of degeneration and not evolution. Even to explain the mere existence of radium, uranium, etc., the evolutionist must flee into the hazy, abysmal past behind the supposition that the processes of radioactivity were once opposite to what they are today. If evolution of the elements has occurred, it would seem reasonable to suppose that somewhere in space bodies would contain elements not found on earth. Dr. Harlow Shapley of the Harvard College Observatory says, however, that the chemical elements in the most distant nebulae are identical with those on earth. Burbank and other scientists produced many new varieties but not new species. The primitive men, referred to by R.H., consist largely of plaster of Paris and imagination. From a lower jaw is constructed Mr. Heidelberg with his gorilline cranium despite the fact that jaw bones of the natives of New Caledonia, who have full-sized brains, are decidedly similar in general characteristics to those of the Heidelberg man. When the Piltdown fossils were submitted to different experts for reconstruction, there resulted as many types of skulls as there were experts. These and many other similar cases give us reason to doubt seriously the authenticity of "missing links."—R.H., South Sutton, Mass.

Can't Get His Balloon Off the Ground

I HOPE this letter will attract the attention of one of our readers. I have made several attempts to inflate a rubber balloon with home-made hydrogen. I was able to inflate the balloon but it would never rise after it was inflated. I think that a spray of hydrochloric-acid vapor gets into the balloon and makes it too heavy. Will some reader please help me out by suggesting a way I can overcome this difficulty? I have been a reader for many years. Keep up the good work on your chemistry and radio pages.—P.K., Omaha, Nebr.

Seconds the Motion For Flag To Banish Armies

UPON reading the letter of T.C.M., Middletown, Ohio, in the September issue concerning the flag to protect art, I decided to send in remarks I wrote after reading the article about the adoption of this flag. It is too bad the League of Nations spends time figuring on a flag to protect art in case of war. I am sure the mothers of the various nations would much rather have a flag to protect their homes and families. If the home is protected so is the peace of the world. Posterity may say, "What fools these mortals were! Saved their art and slew the best physical and mental powers it were possible for us to inherit." That is, if the descendants of the feeble minds and bodies left after another war would ever advance to such thoughts.—H.H., Tucson, Arizona.

Maybe the Trip Down Is Worth the Trouble Going Up

NOT long ago I read an account telling of the observations by antarctic explorers of a queer habit which penguins have. Great numbers of these birds, it is reported, will climb to the top of icebergs, sometimes as high as 100 feet, and then slither down the ice to the bottom. As soon as they reach the bottom, they again begin to work their way to the top, only to slide later to the bottom. More recently I read a newspaper item telling how the penguins in the New York Aquarium are let out of their inclosure after visiting hours and these captive birds promptly begin climbing the stairs leading to an overhead gallery. Surely there must be some biological reason for this unusual habit of climbing by a bird which is poorly equipped by nature for walking. I would be greatly interested to learn what scientific explanation some biologists among your readers can offer for this apparently purposeless effort expended by penguins?—H.W., Scranton, Pa.

Flag To End War Gets Razzberry Salute

I GOT a laugh out of the letter of T.C.M., of Middletown, Ohio, which you published in Our Readers Say under the heading of "A Flag To Make Armies Disappear." This optimistic pacifist suggests a flag that would signify "that the occupants of the dwelling or building flying it were not in sympathy with the war activities in progress and, as such, were immune from attack." What difference would it make to an enemy army (or a friendly one, either, for that matter) whether T.C.M. was "in sympathy with the warlike activities" or not? You can't slap a general on the wrist. I suppose that if T.C.M. were in the path of a hurricane, he would hoist a flag to signify that he was "not in sympathy with the atmospheric disturbances in progress." But would he be immune from having his house blown over into the next county? I doubt it.—K.C., St. Louis, Mo.

Doesn't Need Microscope To See the Dust

I HAVE a laboratory in which I carry on various types of microscopical experiments and up to the present time I have worked out for myself all the seeming difficulties encountered in keeping a laboratory orderly and in taking good care of the equipment. But now *dust* has me stumped. Being a reader of Our Readers Say, I am writing with the thought that perhaps some reader can help me out by letting me in on the secret of how he succeeded in combating dust. The readers of P.S.M., I feel certain, are about unanimous in their belief that the articles on microscopy should continue.—C.C., Burlingame, Calif.

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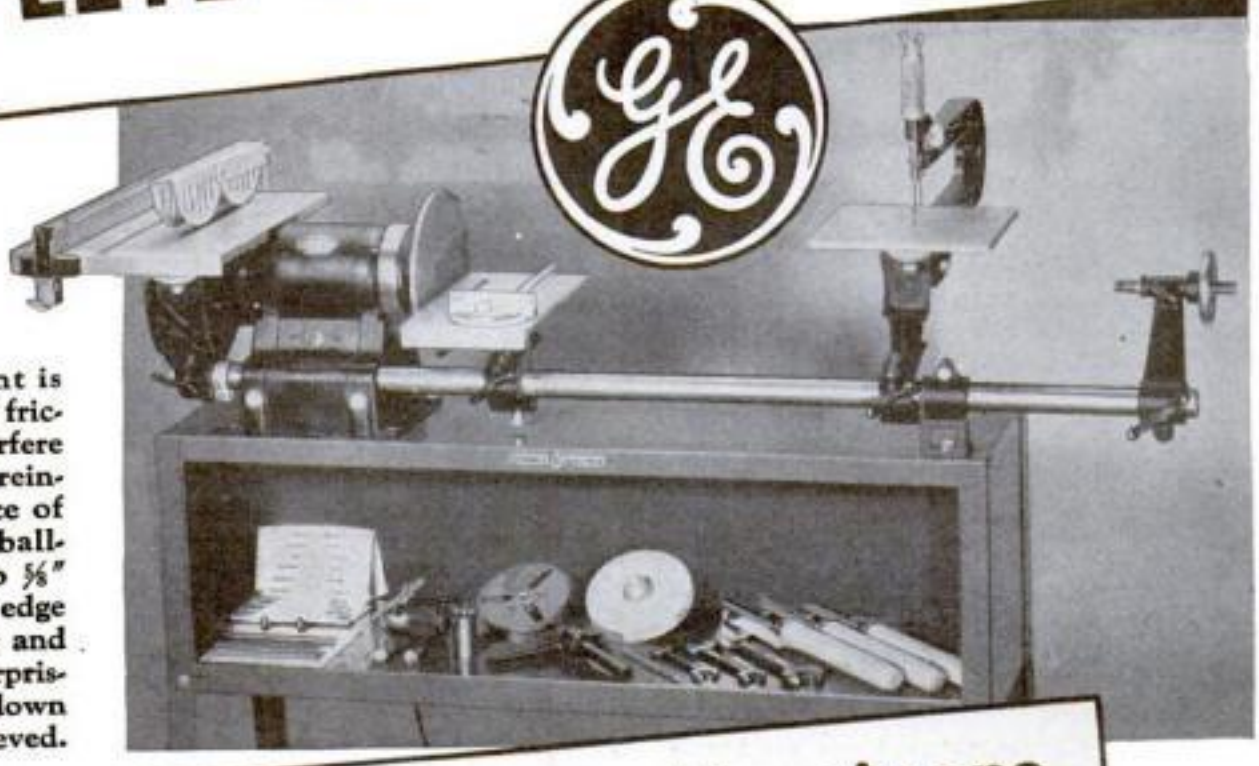

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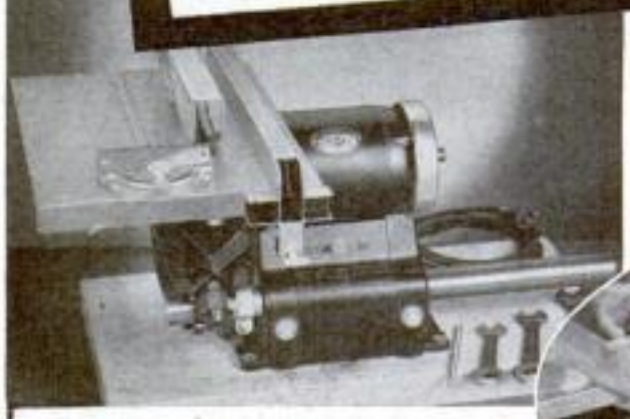

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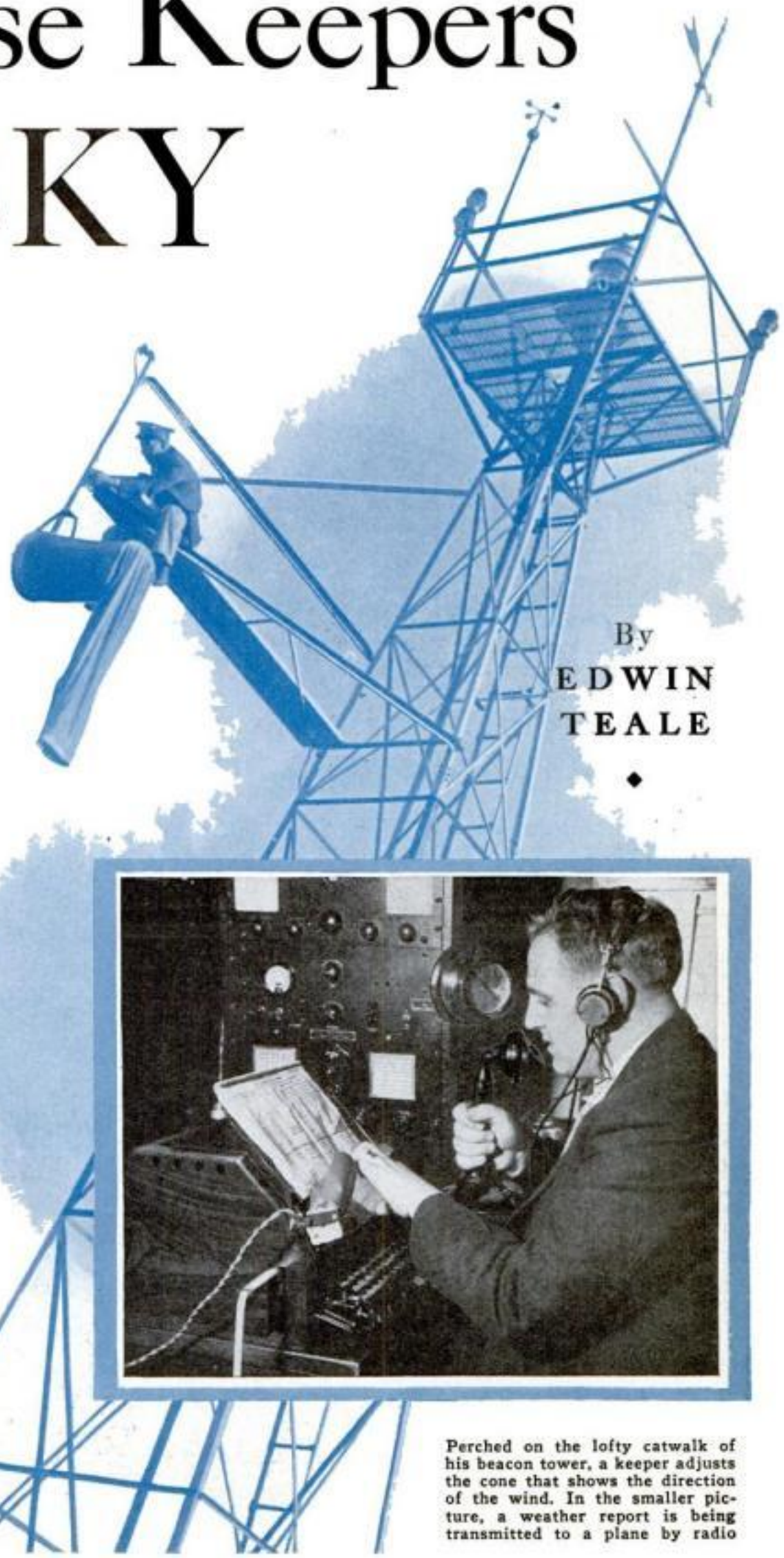
POPULAR SCIENCE Monthly

NOVEMBER 1935 VOL. 127 No. 5

RAYMOND J. BROWN, Editor

Lighthouse Keepers of the SKY



By EDWIN TEALE

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ALONG the vast, 20,000-mile network of American airways, lonely little lighthouses play their vital part in our new air commerce. Amid mountains, in forests, on deserts, airways keepers at emergency fields send out their signals night and day. With radio beams and beacon lights, they guide tons of flying metal through the sky.

The drama of the air is known to all. The drama of the ground—the battles against wind and sleet, heat and blizzard, rattlesnakes and lightning, that enable these men to keep their signals flashing—is known to few. In lighthouses of the air, the grit and courage of the keepers is carrying on the age-old tradition of lighthouses of the sea.

Take, for example, Charlie Merchant's battle with a blizzard in Southwestern Wyoming.

Merchant was on duty at the lonely Knight station when the storm broke. All the way from Porcupine Ridge on the east to LeRoy on the west, the air was seething with snow. Rushing toward the blizzard at more than two miles a minute was a passenger plane of a transcontinental line. Over Porcupine Ridge, it disappeared in the whirling clouds of snow, following the radio-beam signals from Knight.

A few minutes later, Merchant picked up a message from the plane. The receiving set was dead. The pilot was calling the air-line office at Salt Lake City for help. He would circle where he was, he reported, until another liner arrived to lead him through the storm. As Merchant heard the second ship radio it was nearing the ridge, there was a rasping sound in his range receiver. The beacon signal, upon which both ships now depended, was out of order.

Rushing from the station, Merchant found that an aerial wire had snapped in the cold and grounded itself in the snow. From top to bottom, the high radio tower was a sheet of ice. Merchant

This Vivid Article Tells Of the Adventures of the Men Who Keep the Signals Flashing Along Our Far-Flung Airways To Guide Traffic in the Sky

Perched on the lofty catwalk of his beacon tower, a keeper adjusts the cone that shows the direction of the wind. In the smaller picture, a weather report is being transmitted to a plane by radio

hugged the ladder and, with the gale howling around him, worked his way up the glazed rungs. At the top, he improvised a temporary splice which kept the signals on the air and guided the passenger planes to safety.

Such dramatic jobs are often part of the day's work for an airways beacon keeper. In the crisp language of the service, you find on the record books of the various stations similar tales of grit and daring. One man, for example, clung to a rocking tower for three hours in a high wind to keep his beacon going. Another swam nearly two miles through a raging flood to bring materials needed for repairs. At the 272 intermediate fields, maintained for emergencies by the U. S. Department of Commerce, the men in charge are constantly on their toes, alert for trouble.

When the Government establishes an emergency field on an airway, it buys or leases the land from the owner. Experts study the soil as well as the topography of the country and often special grass seed, suited to the soil and climate, is planted to give the field a solid turf. Knocked-down buildings, which can be transported and set up easily, are used at many fields.

Typical of the larger stations is one at McConnellsburg, in the mountains of western Pennsylvania. Its field stretches north and south between two ridges that rise 1,000 feet above it. At the northeastern corner, a high red-and-silver tower supports the light beacon, a four-room building houses the teletype, radio, and meteorological equipment, and a smaller shed contains the apparatus which sends out by radio at regular intervals the identifying letter of the station.

Three men comprise the staff at the field. Charles E. Irish, the airways keeper in charge, is a veteran of the Coast Guard. The two assistant keepers are Robert Johns, a former radio operator on transatlantic tankers, and J. R. Simpson, a Bureau of Air Commerce man from Sunbury, Pa. Every minute of the day and night one of the men is on duty.

Requirements for the job of an airways keeper are physical fitness, a general knowledge of mechanics, and experience as a radio operator. Salaries run from $1,260 to $3,000 a year, and men are chosen by Civil Service examinations. They handle messages over the teletype, broadcast hourly weather reports, give information to pilots flying overhead, keep the light and radio equipment in order, and render assistance to planes making emergency landings.

This last phase of the work produces sufficient excitement to keep life at an emergency field from becoming dull.

Not long ago, for example, McConnellsburg was the scene of a thrilling battle to save a big plane from the wind. Forced down by bad weather, a large monoplane, carrying gas bombs for use in a prison riot, side-slipped into the field, rocking in the gusty air. Hardly had the wheels stopped rolling when the pounding side gusts threatened to overturn and wreck the ship. Both the pilot and the airways keeper battled to anchor it down. Finally, they succeeded in swinging its tail into the wind and securing it with stakes and ropes.

Last year, during a fifty-five-mile-an-hour gale, a gypsy pilot in a light plane

Inflating a rubber balloon with hydrogen gas to test wind conditions aloft

This automatic mechanism flashes out by radio the identifying letter of the field at twelve-second intervals. The motor revolves a cam to produce contacts

A keeper replacing a lamp in a boundary marker at an emergency landing field

A direction marker, outlined in whitewashed rock, serves as a guidepost for passing flyers

sat down on an emergency field near Medicine Bow, Wyo., with his gasoline tanks virtually empty. As soon as his plane came to a stop, he leaped out, grabbed a wing tip, and attempted to hold down his ship. But his weight was insufficient. At every gust, the light machine rose from five to a dozen feet and sailed backward across the field with the pilot clinging to the wing. The airways keeper rushed out with ropes and stakes. However, no sooner would he begin driving a stake into the ground than the plane would sail backward another hundred feet and he would have to start all over again.

The owner of the ship was almost ready to abandon his plane when one of the assistant keepers drove his car on the field and tied a wing tip to the bumper. This held the plane steady until a second auto could be brought and secured to the other wing. Then the plane was towed to a sheltered spot and anchored down.

As an aid to such work, the Department of Commerce is now distributing a new type of anchor. Made of iron, it bores into the ground for six feet or more to give added holding power.

At the McConnellsburg emergency field, autogiros have drifted down in fogs, passenger ships have swooped to a landing in snowstorms, light planes have come down for gasoline, Army bombers have landed in gales and ships with their radios out of order have dropped in to get reports on the weather ahead. Frequently, private planes with small receiving sets but no sending apparatus will swing over the field and give their engines three blasts. That is the signal for the latest weather reports. The man at the microphone broadcasts the data to the plane above and, with one blast of his engine to express his thanks, the pilot flies away.

Not only airmen, but others as well, are now making use of reports from airway stations. In the Middle West, a power company listens in on the weather reports every day to get tips on coming storms and early dusks which will mean peak loads for electric current. Steamship lines are getting the weather data for passengers coming into port. Motor clubs and filling stations are supplying tourists with similar information and a railroad dispatcher in the Northwest uses the reports to tell whether trains on long hauls will be bucking head winds. This helps him forecast late and early arrivals.

PROBABLY the queerest of the odd uses to which the airways service has been put is one reported from Utah.

Last summer, the continued dry weather lowered the water in Great Salt Lake until the revolving beacon on Antelope Island could be reached by wagon instead of by boat. Airways mechanics from the mainland loaded fresh tanks of acetylene gas into a wagon and headed out over the dirty white crust and the shallow water of the lake bed. By the time they had finished servicing the beacon, night was falling.

Starting back over the flat surface on their seven-mile journey home, the men had no landmarks to guide them. If they got off the track in the darkness they might sink into a hole or be mired in a soft spot. However, far ahead, they saw the recurring flash of a revolving beacon. It was the mainland station from which they had come. Pointing the nose of their horse toward the light, they let their own beacon guide them home in safety!

Recently, at the larger airways fields, the government has been installing a new-type radio beacon. Instead of having antenna wires at the top of the high towers, it has them buried in the ground. So sensitive are these installations that an automobile driven on the field near-by may interfere with their proper operation.

In the South, last year, one of these beacons developed mysterious trouble. It was finally traced to wandering cows. The animals were coming near the towers and upsetting the adjustment of the transmitter. In the end, a fence had to be built around the installation to keep the cattle away.

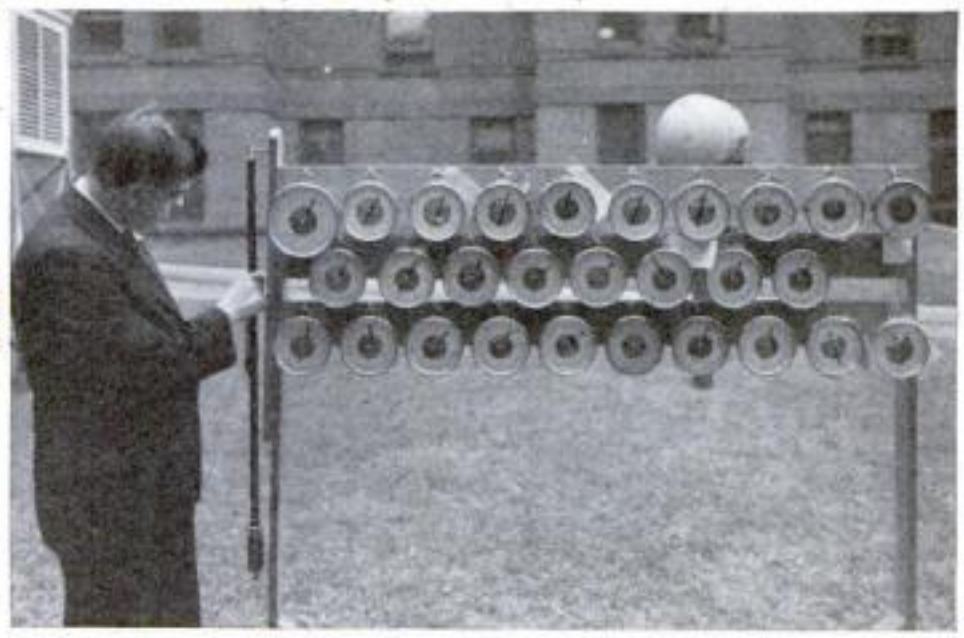
Even stranger was the source of disrupted service at Amarillo, Tex.

One spring, thousands of large, brilliantly colored moths invaded the field. They fluttered about the lighted windows of the radio shed and coated the outside of the building. For weeks, they continued to come. At the same time, fuses began to blow out and pilots reported the radio beacon signals were out of order. Every source of trouble was checked and finally the men at the field discovered the clustering moths were grounding the antenna wires, causing short circuits and loss of energy.

Even after the cause of the trouble was discovered, the remedy was far from easy. Charles Irish, who was stationed at Amarillo at the time, went up and swept off the moths with a broom. They came back as fast as he removed them. Then he sprayed the insects with poison. Others took their place. Finally, he installed a brilliant light on a post a hundred yards from the radio shed. This attracted the moths and eliminated the curious cause of the trouble.

Overcoming the unexpected by ingenuity of this kind is a feature of the airway keeper's work. The cardinal rule of the service is: The signals must stay on the air.

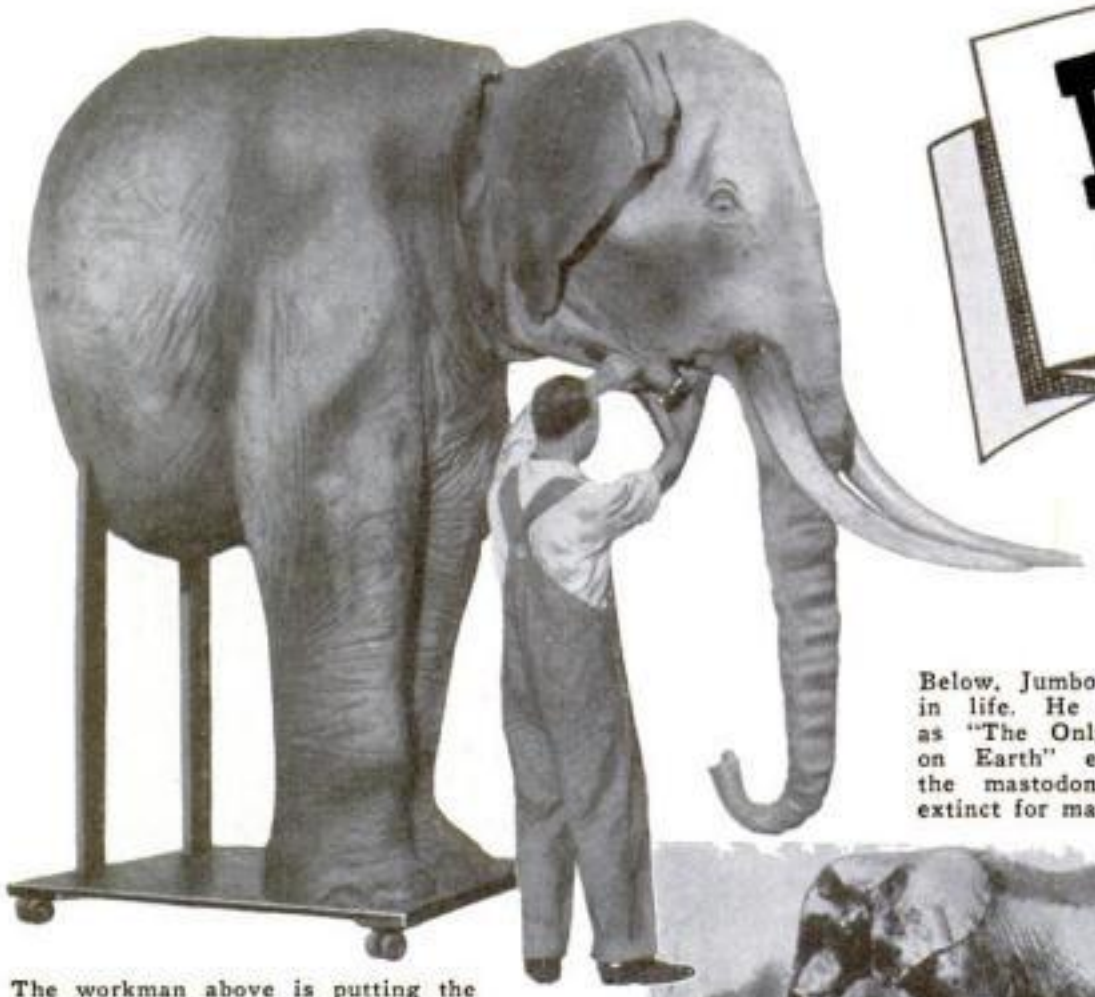
Not long ago, at a station in Iowa, emergency repairs were made with a rubber band to keep an automatic broadcasting apparatus working. The spring bracket on the key which makes and breaks electrical contact in such a way as to send out the identifying code letter of the station at twelve-second intervals, *(Continued on page 111)*



Twenty-eight aneroid barometers for airways service stations being tested by the U. S. Weather Bureau. Increased demand for this service necessitated group testing

Below is shown the combined radio communications and radio range beacon station at Elizabeth, N. J. It is controlled from the airport at Newark

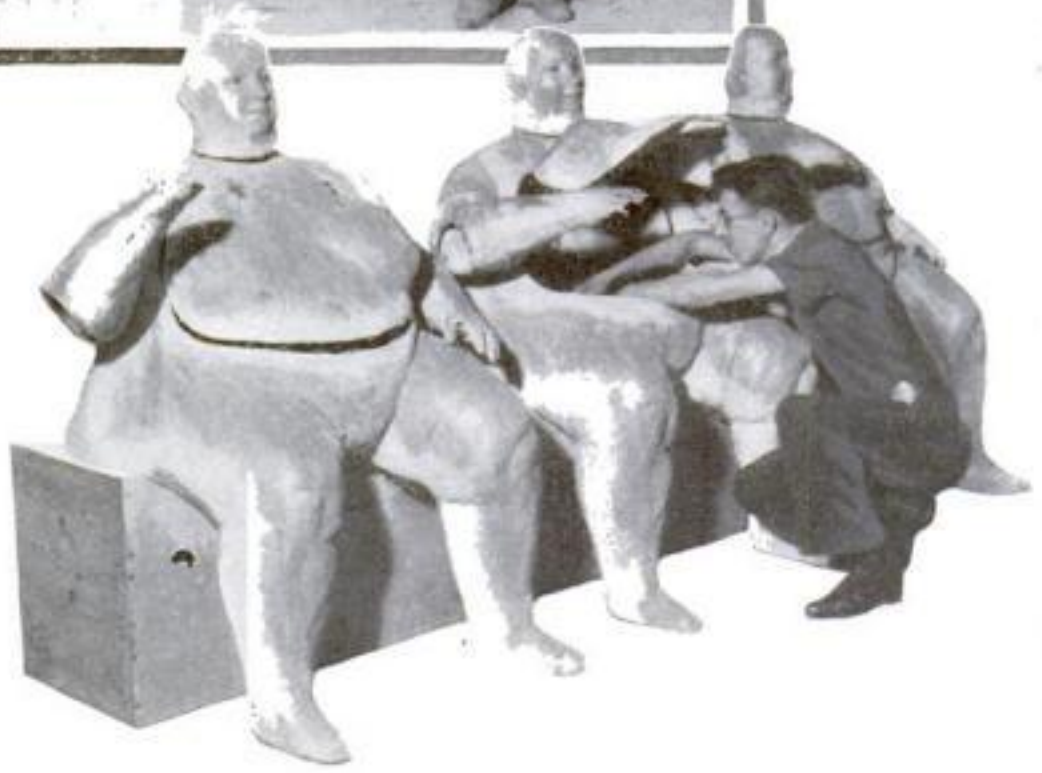
Barnum's REPRODUCED IN



The workman above is putting the finishing touches on the life-size model of Jumbo, the famous elephant

Below, Jumbo as he was in life. He was billed as "The Only Mastodon on Earth" even though the mastodon has been extinct for many centuries

Lifting a section of the mold for the Cardiff Giant from the drying ovens preparatory to removing the papier-mâché cast. The sections of the cast then were assembled, mounted, and fitted with the control mechanism and motors



Through cogs and rods, noiseless electric motors will animate the models. Here a workman is installing breathing apparatus in one of three models of the famous Fat Lady who once attracted crowds to the museum

BARNUM and his freaks—Tom Thumb, Zip, Jumbo, Jo-Jo, and a host of other oddities made famous by the great American showman—will come to life in a unique exhibit now nearing completion in New York City.

All of the figures, from the two-foot Tom Thumb to the thirty-foot whale, will be exactly life size. They will move, breathe, and many, through sound effects, will talk. The whole exhibit, which will be nearly half a block long, is being prepared by Messmore and Damon, creators of "The World A Million Years Ago" attraction at the Century of Progress Exposition in Chicago.

Visitors will walk down aisles between the various mechanized figures as though they were in Barnum's American Museum, three quarters of a century ago.

They will see the Cardiff Giant, the "Fejee" Mermaid, the Woolly Horse, the Russian Giant. They will see "The Only Whale in Captivity" open and close its mouth, spout water, and splash its tail in the huge tank. They will see the Fat Lady, "a quarter-ton of feminine charm," fanning herself and breathing realistically. They will hear the chatter of Zip, "The Great What-Is-It?"; the roar and snarl of lions and tigers; the tribal chants of "The Congress of American Indians."

The Rubber-Skinned Man will show the way he can stretch the skin of his chest and sides. The Siamese Twins will hold a conversation. And, the Tattooed Man will tell the story of how he became a living picture gallery. As a final attraction, a curtain will part and P. T. Barnum, himself, will introduce Jenny Lind, "The Swedish Nightingale," who will sing one of her songs.

Most of the mechanized, life-sized figures are being formed of papier-mâché braced with steel and canvas. The thirty-foot whale will weigh more than a ton and its framework, alone, will contain more than 3,000 feet of heavy rattan.

Jumbo, "The Only Mastodon on Earth," will tower eleven feet six inches in the air and will tip the beam at more than two and a half tons. Moving its head, lifting its great ears, switching its tail, and, at intervals, raising its trunk to trumpet, this mechanical monster will be an exact reproduction of the largest elephant ever exhibited in captivity.

Through cogs and rods, silent electric motors within the immense body will produce movements at the will of an outside operator handling a switchboard. In the smaller attractions, such as the Sword-Swallower and the Albino, the motor and operating mechanism will be located in a box below the feet of the figure.

In making the original model of Jumbo,

Museum WORKING MODELS

Messmore and Damon with a preliminary model of their unique mechanized display. The completed exhibit will be 110 feet long

the experts employed more than four tons of clay. The steps in producing the giant elephant illustrate the way in which most of the animated figures are created. First, the workers molded the clay around a rough wood-and-wire frame until it attained the appearance of the original animal. Then they covered the clay with plaster of Paris. This was later cut away in sections to form the cast. Into the sections, the men pressed layers of wet papier-mâché until they had built up the desired thickness. Placed in a huge drying oven, the sections then were subjected to temperatures of from 200 to 210 degrees F., for as long as fifteen hours.

At the end of this time, the papier-mâché shell was thoroughly dried and could be removed from the cast. The final steps were joining the sections, installing the internal bracing, and putting in the electric motors and mechanisms for producing motion. Then, after the figures had received their final touches to increase the naturalness of their appearance, the work was done.

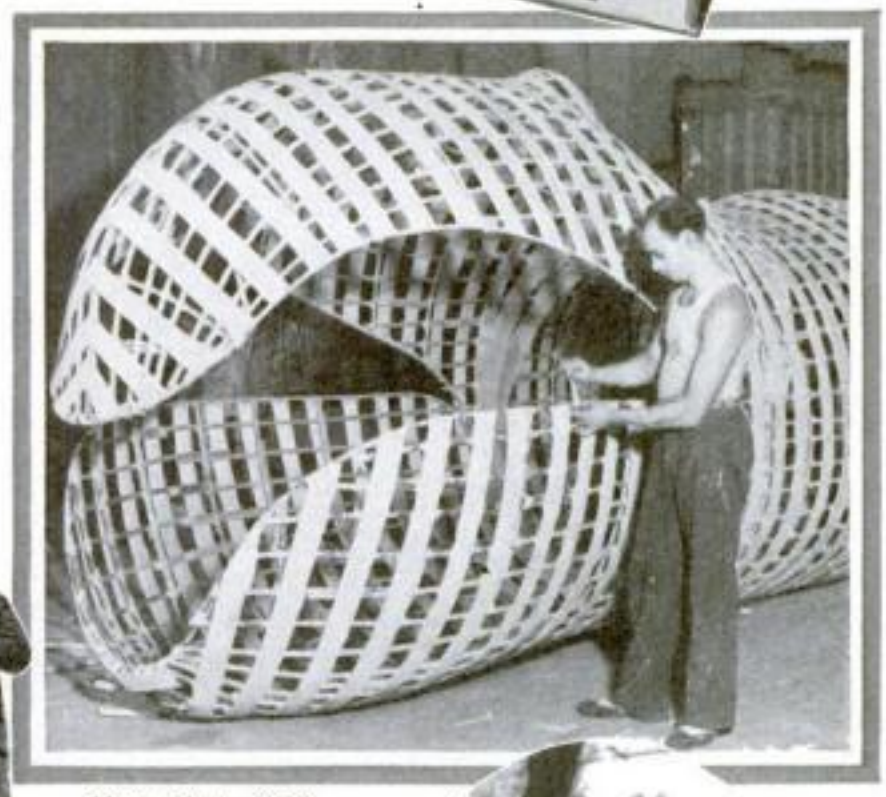
Recently, vulcanized sponge rubber has solved a difficult problem in connection with talking figures. Like the puppets of ventriloquists, they have moving jaws. The problem is to hide the joints where the jaws are hinged. In the case of the Bearded Lady, this is easy because her beard covers them. But, in planning to have Tom Thumb tell of his famous visit to Queen Victoria, the experts realized joints in the face of the beardless midget would be harder to conceal.

By the use of the sponge-rubber masks, vulcanized on steel molds, the difficulty has been overcome. As the jaw moves, synchronized with the disk record which produces the sound effect, the rubber mask creates an illusion of contracting and expanding jaw and face muscles, a highly realistic performance which was impossible before.

Similarly, when Zip shrieks and chatters, when the Indians chant to the beat of tom-toms, when the Living Skeleton harangues the audience, the new material employed for the faces will add to the illusion of reality.

Several of Barnum's classic fakes and practical jokes are included in the exhibit. One is the "Horse With Its Head Where Its Tail Should Be." It is a horse turned around in its stall so its tail is next to the manger. Over a door at one corner of the exhibit is the sign: "This Way to the Egress." When Barnum found people were bringing their lunches with the intention of staying all day at his museum, he would put this sign over an exit door. Thinking "the Egress" was another curiosity, the visitors would *(Continued on page 113)*

Here is Barnum himself, pictured with the midget, Commodore Nutt



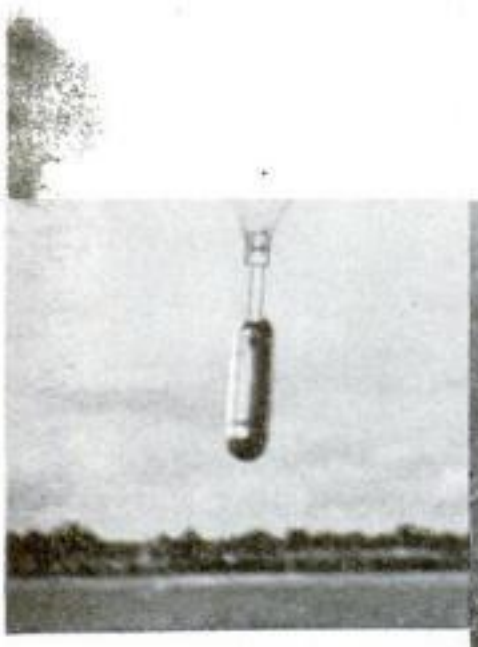
More than 3,000 feet of rattan went into this skeleton of the "Captive Whale"

Building up a section of Zip by pressing layers of wet papier-mâché into a mold made up of plaster of Paris

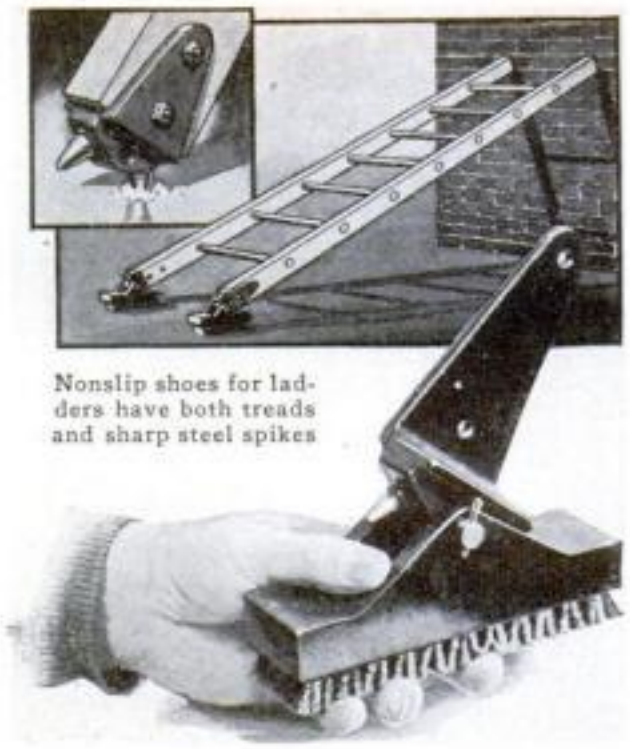
In many of the smaller models, the operating mechanism is hidden in the base on which the figure stands, as above

TEST NEW PARACHUTE FOR THE DOGS OF WAR

FORESEEING that troops may be dropped with parachutes from speeding planes, in future wars, Soviet experimenters are trying out a similar means of landing the dogs used in army service. A recent invention is a cylindrical coop for the dog, provided with a parachute that opens automatically when it is tossed from a plane. The shell of the coop, locked closed during the descent, springs open of its own accord when the device strikes the ground. The photographs reproduced here show the device in action during recent successful tests by Soviet aviators.



Parachute descending with army dog. At right, coop opened after landing

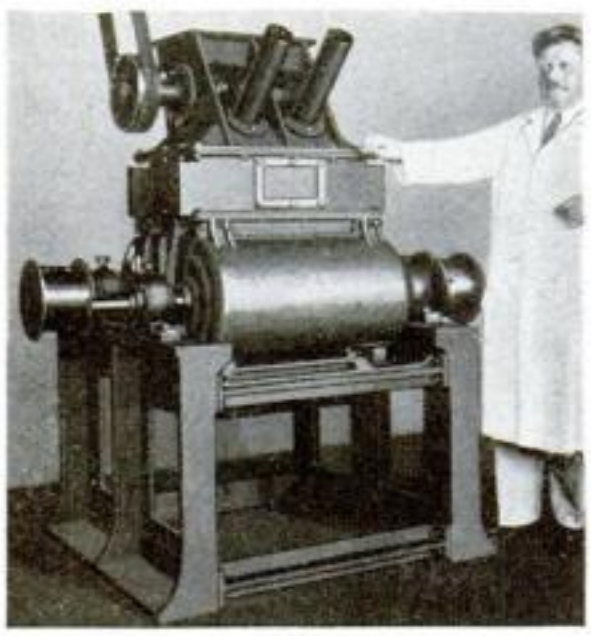


Nonslip shoes for ladders have both treads and sharp steel spikes

LADDER SHOES PROVIDE SKID TREADS OR SPIKES

SAFETY SHOES of new design, fitted with treads of automobile brake lining, can be attached to any ladder and are said to prevent it from slipping when slanted at any angle, even in oil, grease, or water. For use in icy inclines or other places of special danger, the hinged bases may be removed, exposing sharp steel spikes.

MECHANICAL RAT FINDS WAY IN MAZE



Driven by an electric motor and controlled by mechanical feeders, this robot rat finds its way through the artificial maze at the right

AS IF endowed with powers of reasoning, a mechanical "rat" devised by Dr. Stevenson Smith, University of Washington psychologist, threads its way through an artificial maze like those used to study the behavior of living rats. The three-wheeled, electric-powered device moves along a grooved path that divides at several points, obliging the "rat" to choose which direction to follow. If it takes the wrong turn and enters a blind alley, mechanical feelers cause it to halt, retrace its journey, and try again until the whole course is negotiated successfully. The odd model is designed to show how automatic reflexes differ from thinking processes.

NEW PLAN PROPOSED FOR STOPPING ENEMY PLANES

FOR DEFENSE against enemy air raids, a French inventor proposes a novel scheme to stop the motors of hostile planes in mid-air. His plan is to saturate the atmosphere with finely powdered pitch, discharged from motor-driven blowers that would be giant counterparts of the small model illustrated above. Penetrating the hot motors of aircraft, he contends, the melting pitch would immediately clog them and put them out of service.

Inventors of many countries have sought a way of halting airplane motors at a distance. The rumored development of various "rays" and other means toward this end, however, remained unconfirmed until Guglielmo Marconi, father of wireless, announced the other day that he is perfecting ultra-short-wave radio apparatus that is expected to prove capable of the feat. All details of the Marconi motor-stopping device are being kept secret.

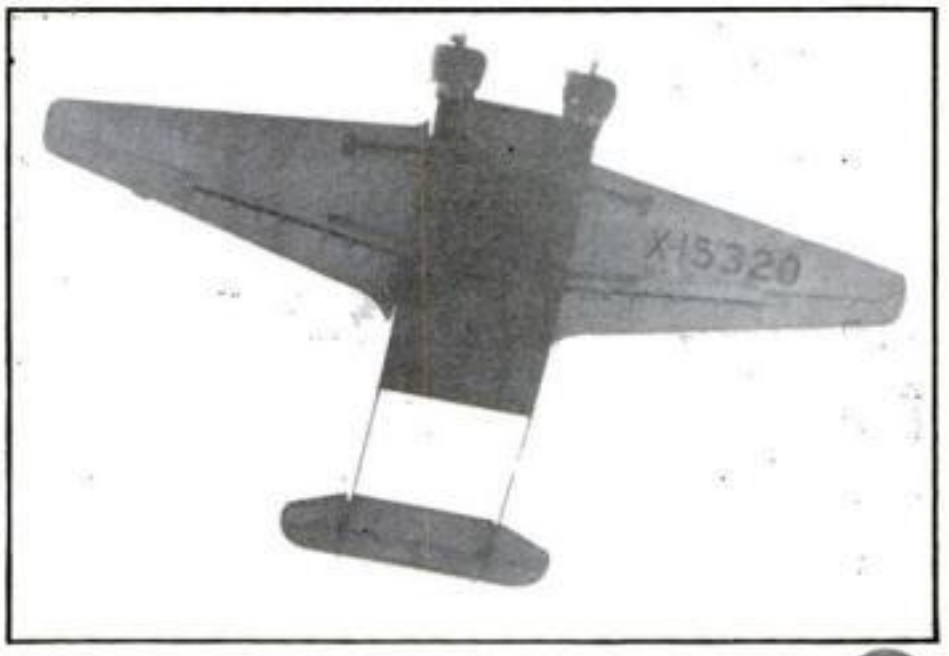
PENCIL HAS BUILT-IN LIGHT

WRITING in the dark is made easy by a new type of self-illuminated pencil. The hollow barrel contains a flash-light battery and a small bulb, and light is directed on the writing, when a switch button at the end of the barrel is depressed, through a transparent window of unbreakable plastic material at the lower end of the pencil.

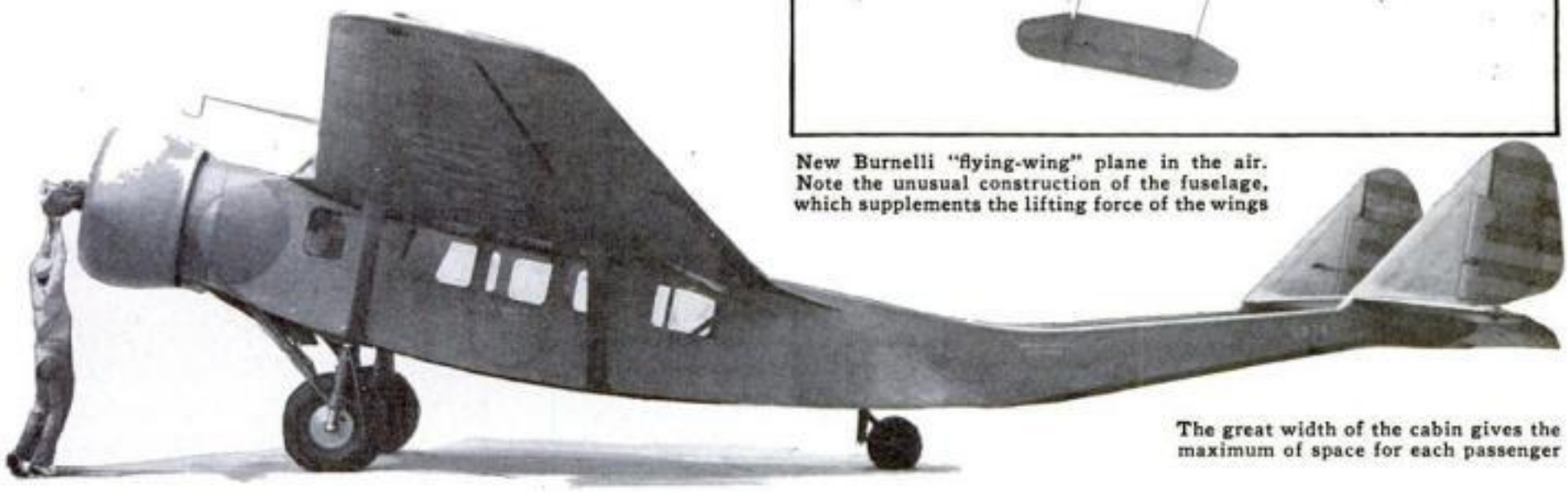
Transparent tip of illuminated pencil, and its tiny lamp. Right, the pencil in use

"FLYING-WING" PLANE HAS LARGE SPACE FOR PASSENGERS

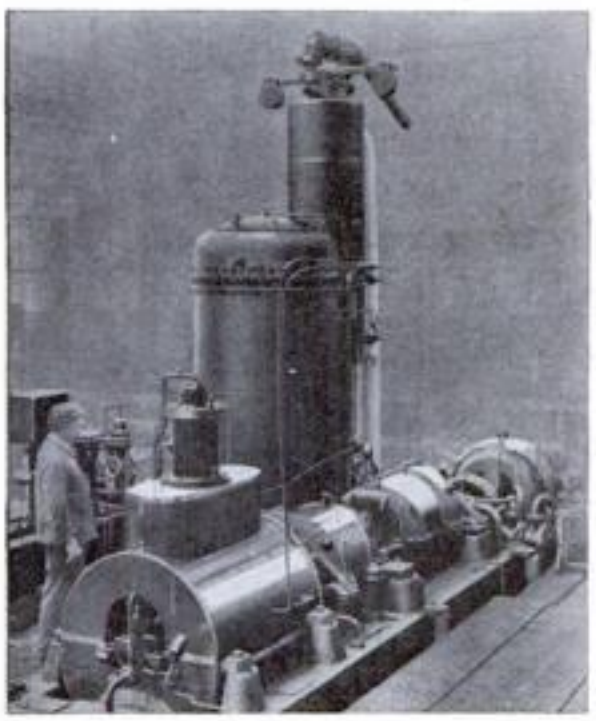
A FOURTEEN-PASSENGER "flying wing" declared to offer more cabin space per passenger than any conventional transport craft built to date is the latest creation of Vincent J. Burnelli, aeronautical engineer of Keyport, N. J. The new model, he says, is suited to high-speed passenger, mail, and express service, and has a maximum speed well over 200 miles an hour. Both the forward wheels and the tail wheel are retracted in flight. As in Burnelli's earlier experimental designs, the fuselage is of exceptional width and is shaped like an airplane wing, so that its lifting force supplements that of the wings themselves. The latter, spanning seventy-one feet from tip to tip, are provided with special flaps of the type known as "air brakes," which permit a safe landing at reduced speed.



New Burnelli "flying-wing" plane in the air. Note the unusual construction of the fuselage, which supplements the lifting force of the wings



The great width of the cabin gives the maximum of space for each passenger

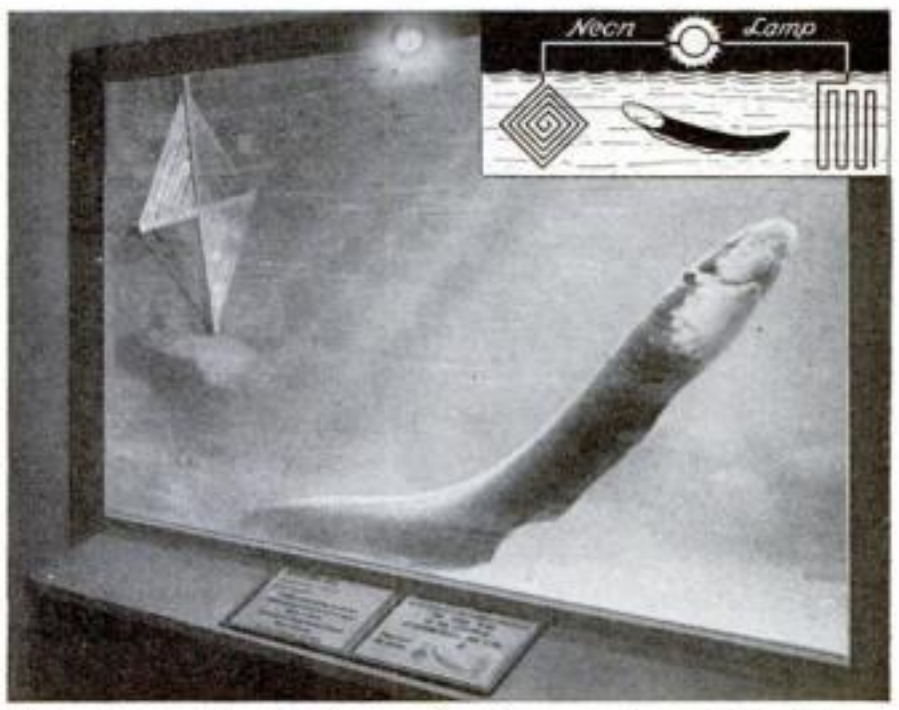


STEAM BOILER FOR SHIPS RIVALS DIESEL POWER

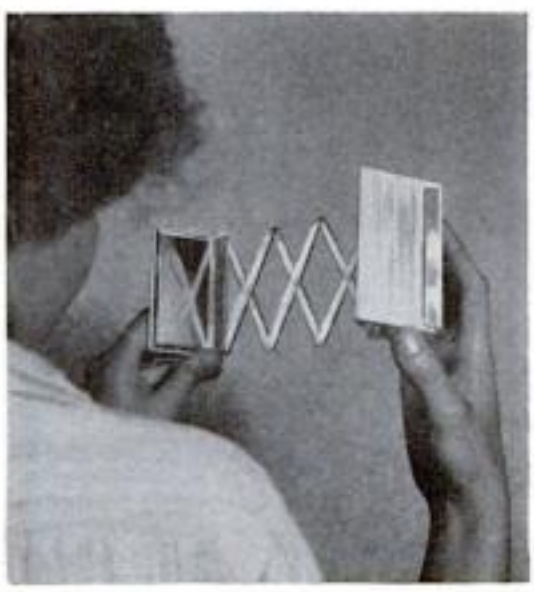
SOON to be tested by the British Navy, a new oil-fired boiler of Swiss invention may have far-reaching applications for warship propulsion. The compact power plant, illustrated above, is declared especially suited to the narrow hulls of submarines and destroyers, and its remarkable efficiency is expected to make steam a competitor of Diesel power where the latter now is used. Air and oil are sprayed at a velocity exceeding 1,200 feet a second into a combustion chamber where steam is generated to drive a steam turbine and electric generator directly connected to the boiler. The swift-moving exhaust gases superheat the steam, warm the incoming water, and yield their remaining energy in a gas turbine that pumps the fuel. Starting cold, the boiler can reach full output in only five minutes' time.

LAMP IS LIGHTED BY EEL-ECTRICITY

TO DEMONSTRATE the power of the electric eel to discharge high-tension currents, officials of the New York Aquarium have arranged a pair of terminals in a tank and connected them to a neon lamp. When the six-foot eel in the tank is disturbed, it discharges a current and the lamp glows. The species uses its shock-giving power for capturing prey by stunning it, and for defense against enemies. The shock is declared powerful enough to incapacitate a horse.



This electric eel furnished power for a lamp, as shown in the diagram



Double mirror in use for inspecting the back of the head. The frame folds up

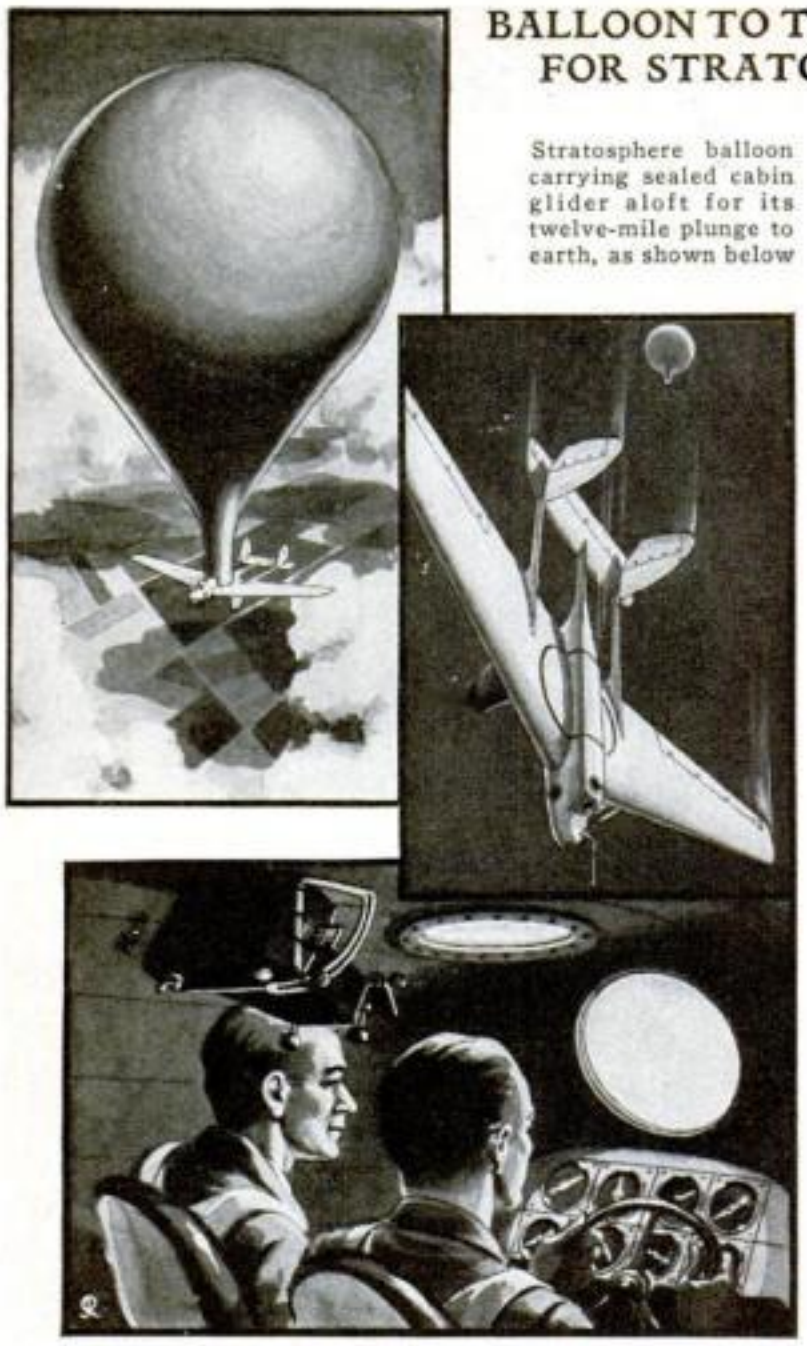
REAR-VIEW MIRROR SHOWS THE BACK OF THE HEAD

SMALL enough to be carried in a woman's purse, a rear-view mirror for inspecting the back as well as the front of the coiffure has been devised by an ingenious inventor. For use, the two reflectors are drawn apart, as shown at left. Looking into one mirror through the other gives a view from the rear.

WATER PIPES IN WINDOWS TO WARN OF JAIL BREAKS

PIPES filled with water would replace solid iron bars for jail windows, in a new plan to thwart prison breaks. Any attempt to saw through a bar would lower the pressure throughout the interconnected system, automatically sounding an alarm.

BALLOON TO TAKE GLIDER ALOFT FOR STRATOSPHERE FLIGHT



Stratosphere balloon carrying sealed cabin glider aloft for its twelve-mile plunge to earth, as shown below

Pilots guide glider while automatic camera records data

PLANS for the first glider flight in the stratosphere are under way in Russia, where a motorless plane will be carried aloft by a huge balloon to a height of about twelve and a half miles and then cut loose. Enclosed in a hermetically sealed cabin, the copilots of the glider will guide its initial plunge toward the earth at an estimated speed of more than 250 miles an hour, made possible by the rarefied air of the upper levels of the atmosphere, and level it off for a gradual glide to a landing. An automatic camera, meanwhile, will photograph speed- and pressure-recording instruments at five-second intervals to provide permanent records. Data thus obtained will be of assistance, it is expected, in the design of future airplanes that may be used to inaugurate transport routes through the stratosphere. During the projected ascent, the glider will be supported by a special frame within the lower part of the gas envelope, which will have a capacity of more than 800,000 cubic feet. The pictures show our artist's conception of the flight.

Unsinkable German boat in use and, at right, as it appears when it is capsized. Air tanks at front and rear keep it afloat

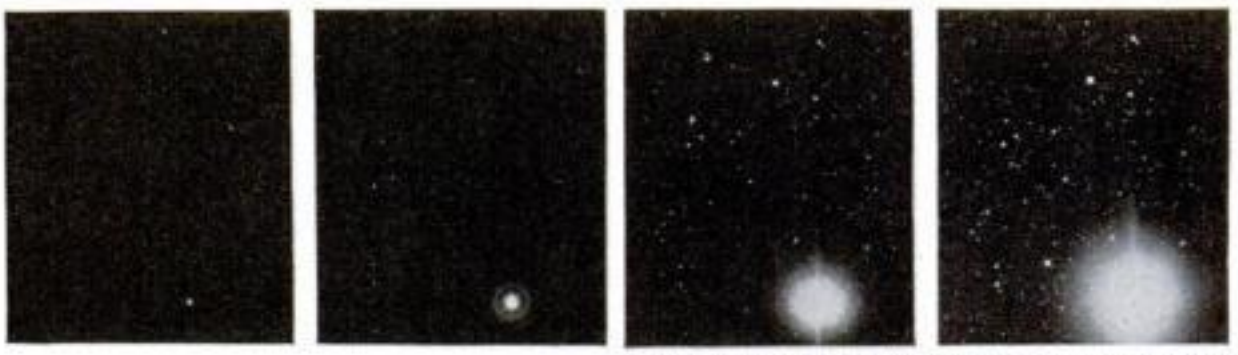
REVERSIBLE BOAT TAKES DANGER OUT OF UPSETS

NO FEAR of drowning, in case of an upset, need worry the user of a new German boat, for it is practically as serviceable a craft when upside down as when it is right side up. If it capsizes, the victim of the mishap can readily clamber to a position of safety upon the keel. An air tank in the front and two at the back, according to the inventor, make the boat virtually unsinkable.

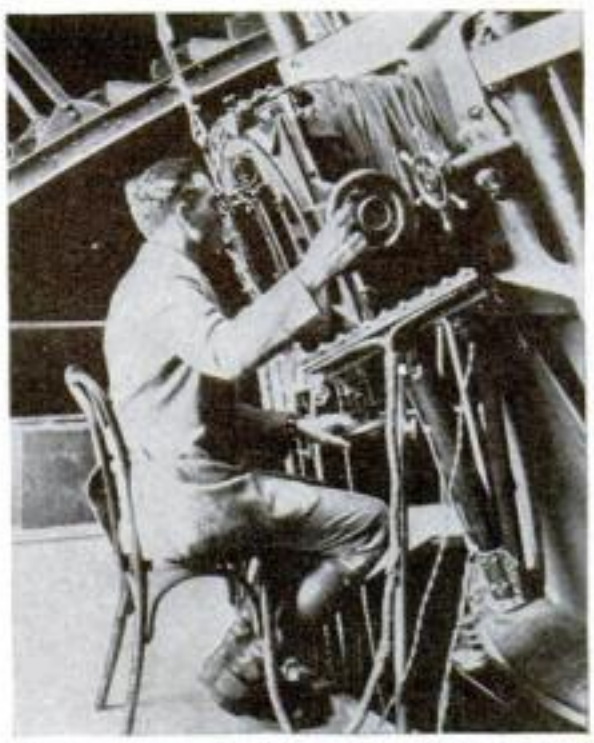
HUGE FRESCOES BRIGHTEN BLANK BUILDING WALLS

TO IMPROVE the appearance of bare exterior walls of a group of apartment buildings being erected in Berlin, Germany, artists recently tried the experiment of covering them with huge fresco paintings. The result is an outdoor art gallery, whose striking effect is reported to enhance the quality of the architectural design. A typical example of the large-scale works of art, depicting a fishing scene, is shown in the photograph reproduced above.

PHOTOGRAPH REVEALS NEW STAR GROUP



Four pictures of the same sky area showing how longer exposures, at right, reveal faint stars

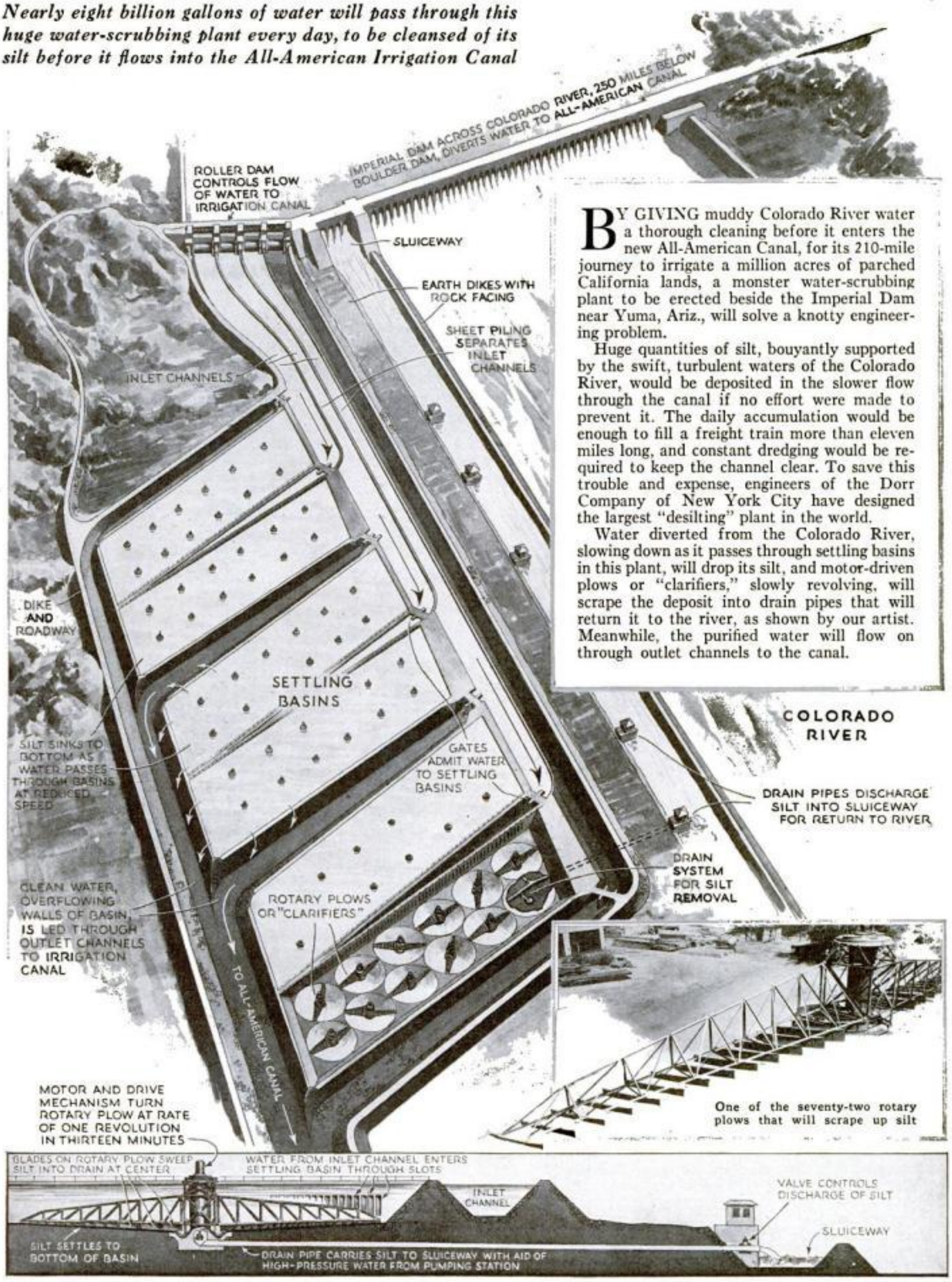


Dr. Hubble manipulating the electric controls that keep the telescope trained upon a star

PENETRATING farther into space than any celestial explorer has gone before, Dr. Edwin P. Hubble, of the Mt. Wilson Observatory in California, recently secured the longest-range photograph ever made. Although unimpressive in appearance to a layman, it shows an unnamed "star city" or cluster, nearly sixteen quadrillion miles distant from the earth—a distance so staggering that the rays of light that reached his camera started toward the earth a half billion years ago. Throughout the exposure of three and a half hours, a delicate clockwork mechanism synchronized with the rotation of the earth kept the giant 100-inch telescope trained approximately upon the center of the star group. Even greater precision was required, however, so Dr. Hubble sat before the sighting eyepiece, constantly regulating electrical controls that kept the image of a star centered upon a pair of illuminated cross hairs.

Washing the Muddy Colorado River

Nearly eight billion gallons of water will pass through this huge water-scrubbing plant every day, to be cleansed of its silt before it flows into the All-American Irrigation Canal



One of the seventy-two rotary plows that will scrape up silt

BY GIVING muddy Colorado River water a thorough cleaning before it enters the new All-American Canal, for its 210-mile journey to irrigate a million acres of parched California lands, a monster water-scrubbing plant to be erected beside the Imperial Dam near Yuma, Ariz., will solve a knotty engineering problem.

Huge quantities of silt, bouyantly supported by the swift, turbulent waters of the Colorado River, would be deposited in the slower flow through the canal if no effort were made to prevent it. The daily accumulation would be enough to fill a freight train more than eleven miles long, and constant dredging would be required to keep the channel clear. To save this trouble and expense, engineers of the Dorr Company of New York City have designed the largest "desilting" plant in the world.

Water diverted from the Colorado River, slowing down as it passes through settling basins in this plant, will drop its silt, and motor-driven plows or "clarifiers," slowly revolving, will scrape the deposit into drain pipes that will return it to the river, as shown by our artist. Meanwhile, the purified water will flow on through outlet channels to the canal.

MOVIE STUNT MEN

Risk Their Lives to Thrill Millions

Riding the top of this falling oil derrick, Matt Gilman leaped through a hole cut in the roof of the building at the right, and landed safely in a life net

By JOHN E. LODGE

NINE times, a movie stunt man plunged into the swirling rapids of a Washington river, swimming forty-five minutes in water twenty degrees below the freezing point. In Southern California, another demolished nine new automobiles in spectacular crashes within a week. A third member of this strange fraternity jumped an untrained farm horse sixty feet into a pool of water; three others walked leisurely in asbestos suits through seven gallons of flaming oil, scattered over a steep stairway. Still another pulled the pin to unloose the tongue of an old-fashioned western stagecoach and plunged down a mountain canyon in the runaway vehicle.

Every day, somewhere on location or within the walls of a Hollywood sound stage, dare-devils who follow the world's most bizarre and dangerous occupation, tempt fate with their courageous feats. Although hundreds of young men offer their services to the studios, willing to undertake the wildest stunt that any director may conceive, seven "old-timers"—veterans in their middle thirties—perform nine-tenths of all the hair-raising episodes you see on the screen.

They "double" for famous actors and actresses whenever the stars' safety is threatened. In Hollywood there are, too, a number of "bump men," athletes who undertake less hazardous swims, fights, falls, and rides. But when any of these "doubles" declines some job which means death if he misses, the casting director calls for one of the veteran stunt men.

These seven are a small remnant of the scores of stunt men who have come and gone with the years, 130 of whom have met death during the performance of difficult stunts for the screen.

Their names—Duke Green, Bob Rose, Gordon Carveth, Cliff Lyons, Yackima Canutt, Frank Clark, and Matt Gilman—you never see on the screen. They appear on a set for a day or two, thrill actors and technicians with their daring, and move on to another job, frequently without knowing even the name of the picture they have helped to make.

Yet, the veterans in the game have evolved a science by which they face serious injury, or perhaps death, a hundred times a year. "Timing and nerve" is the formula a stunt man will offer for his freedom from hurts. He applies principles as exact as is possible to make sure he will emerge unscathed from a four-story fall, an underwater struggle with a man-eating shark, or a plunge off a trestle in a locomotive.

Yet the best-laid plans, skill, and experience do not always save a performer from injury. For instance, consider Gordon Carveth's experience when he answered a call to make a scene at a beet-

AN UNINTENTIONAL THRILL

The untrained farm horse used in this spectacular leap did not do exactly what was expected of him. As a result, the dare-devil rider was caught beneath the somersaulting animal as it struck the water. He suffered a sprained back, but the horse was uninjured

In the photograph below, a movie stunt man is seen wearing the inflated rubber suit which he concealed under his outer clothing for protection in swimming in water at a temperature of only twelve degrees above zero

sugar factory in Chino, Calif., recently.

The director led him up to the fourth floor. "See that open well behind the fence?" he said. "You fight on this side; you take a punch in the jaw and drop backward through the fence. Cameras will catch you falling past each floor, and the net will break your fall below—I hope."

It happened the property man had forgotten to bring along the breakaway fencing, made of fragile balsa wood or desert yucca, so Carveth ordered a carpenter to cut the regular fence in four places. The fight began. Carveth and a professional boxer pounded each other, the pair moving gradually toward the well. When Carveth reached the fence, the boxer struck Carveth on the chin, carrying the punch through to give him added momentum.

The fence gave way like paper and the stunt man rolled himself up for the fall, his knees and hips bent slightly. Instead of landing on his back, as he had planned, the momentum caused him to strike the net feet-first, the force of the blow driving his left knee against his forehead. Within a few minutes a bump the size of an egg rose on his head, but the make-up man "erased" the bump with appropriate shades of grease paint, and Carveth repeated the fall twice before the factory whistle blew at noon.

It was Bob Rose, a wiry little man of 125 pounds, who faced the man-eating shark. He arrived at the studio not long ago, to see property men holding the shark in a portable tank while a muzzle was tied over his mouth. The shark then was dropped into a larger tank, into which the camera peered through a plate-glass window. Five minutes later, the strange battle commenced.

"Never have I experienced a more weird sensation," Rose told me. "I felt sure I could rely on my hands and the clear water for protection, but the creature gave me everything he had in the first round. He tried to ram me with his nose, while I could see his jaws moving in a frantic effort to open. His tail swished every time I dodged, and threatened to knock me through the side. After a half minute, I came to the surface, gulped fresh air, and returned to the battle. Bubbles began to fill the water. While this gave a fine camera effect, it clouded the water so I could hardly see. When I ducked after my fourth trip up, I saw that his muzzle had slipped. No more time for pictures then! I grabbed the ladder and pulled myself over the edge of that tank quicker than a cat climbs a tree."

Protected only by flesh-colored gloves and knee pads, Bob Rose crashes through a glass skylight without injury. In this stunt, speed brings safety

In this realistic jail-break scene, two stunt men fought on a sloping roof. The "policeman" forced the other to loosen his grip on a gutter and fall—into a net

Cameramen filming a scene in which Duke Green swings across a street on a rope in a make-believe effort to rescue a fellow stunt man from the roof of a burning building. The man on the roof finally leaped into a net

Although a slip would have ended Rose's career at that instant, he considers the plunge into a river in a locomotive actually more dangerous. An ancient coal burner had been rebuilt to duplicate a modern Goliath of the rails. A bridge had been weakened to make sure the engine and two box cars would plunge to their destruction. Dressed in a woman's clothing, Rose took his place in the cab, opened the throttle, and roared down the rails. When he reached the bridge, the engine started to crash down through the wooden structure and Rose dived through the cab window into the running water fifty feet below. Timed to a split second, his stunt earned for him $750, and required no more than thirty seconds to complete.

Duke Green has braved the cold waters of many streams in perilous swims, but his nine plunges into the north fork of the Nooksack in four days provided one of the toughest experiences ever tackled by any stunt man. Although he was protected from neck to knees by an inflated rubber suit, intended to give him buoyancy, he lost fifteen pounds during the ordeal of remaining for a total of forty-five minutes in the stream; his clothing froze on his back, three fingers on each hand were frozen as stiff as boards, and he could not breathe normally for two hours after each plunge into the river.

"Cold water takes more out of a man than any other motion-picture stunt," he told me. "Three doctors and two rubbers worked on me every time I came out. I lost my hearing and couldn't understand a shout. For hours, I felt as though I was standing under a freezing shower. When blood began to return to my fingers, which had turned blue from the intense cold, I did not know whether to holler, stand up and cheer, or grit my teeth and bear it."

Despite the skill required and the pain often endured, stunt men as a rule are poorly paid. Many risk their lives for as little as $50. *(Continued on page 120)*

How Railroad Men Talk with Their Hands

One of the most picturesque signals in the railroad sign language is the one that stands for a stock car. The switchman places his opened hands, thumbs in, at the side of his head in imitation of the ears of an animal

To indicate a caboose, the switchman bends his arm inward to his body and pretends to scratch his side. The signal is a relic of the days when the caboose was not as clean a place as it is today

TO SPEED the work of breaking up long freight trains and redistributing the cars on the maze of tracks in a big terminal, railroad men have evolved a sign language of their own. By the use of picturesque signals, yard foremen, switchmen, and yard enginemen can communicate rapidly and accurately. You have probably seen some of these signals in use, and wondered what they meant. The illustrations on this page show some of the common signals used by railroad men.

Making up long trains like this calls for an accurate and rapid way of communicating orders

When a car is to be "spotted," or placed in some definite position for loading or unloading, the fact is conveyed as shown. This signal may also mean that it is "Time to eat"

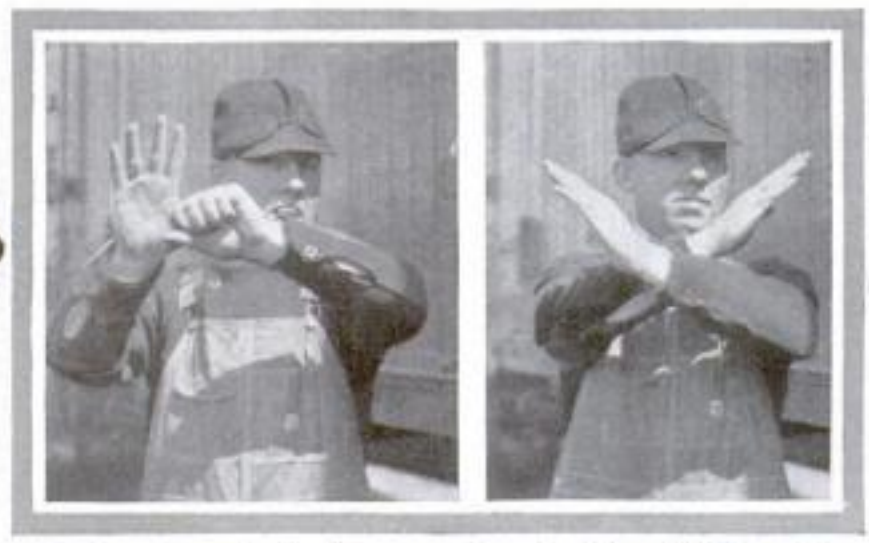
The main-line track is indicated by the signal illustrated above. Every track has its designation

Raising his hands over his head to form a gable, the switchman signals a car to the house track

To send a car to the ice track, the switchman covers his ears as if to protect them from the cold

Even a layman can translate this graphic gesture as telling the engineer to "Give 'em a shove"

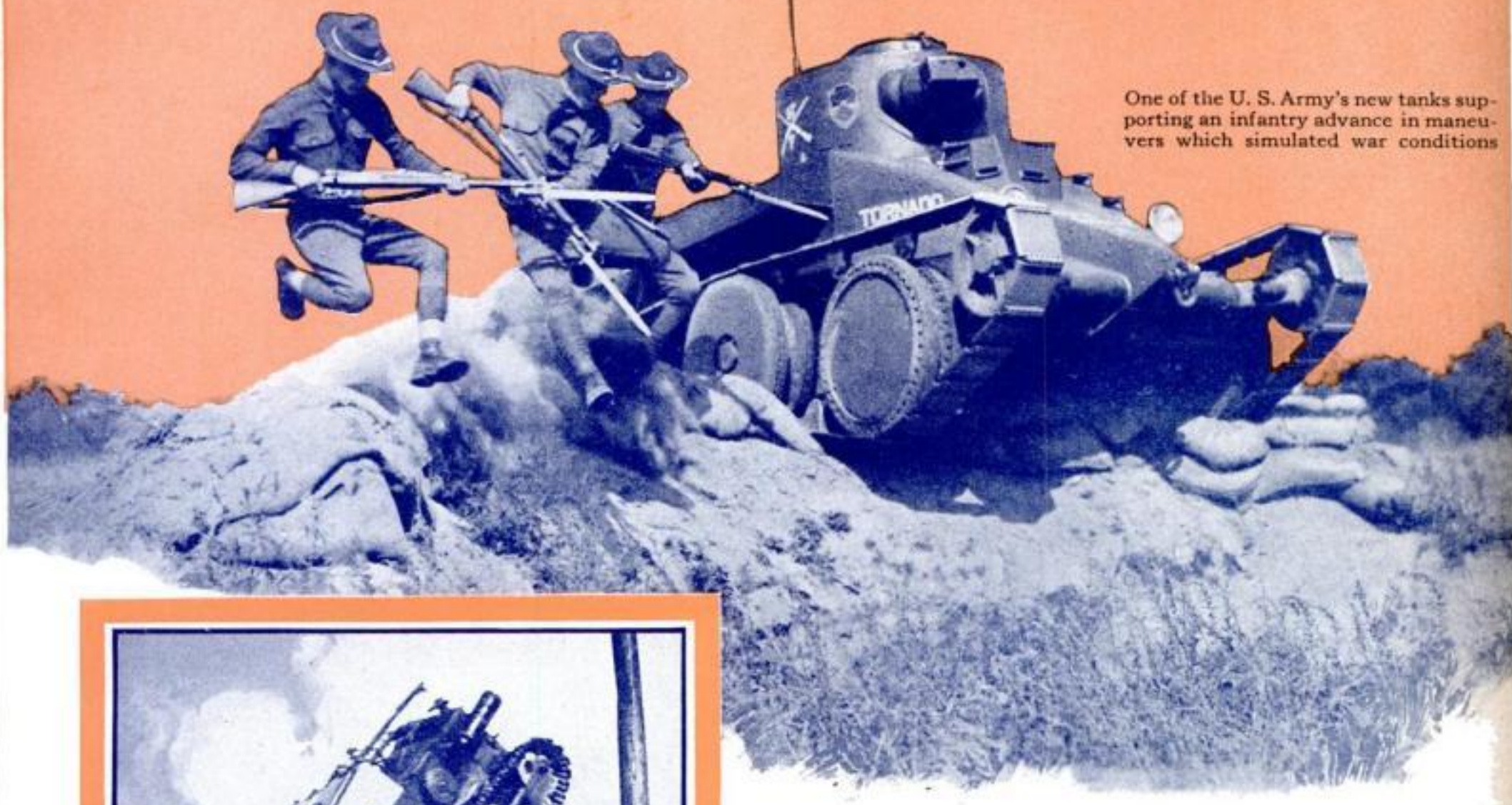
When the switchman raises his hand to his mouth, it means the water car —literally, "Let's stop for a drink"



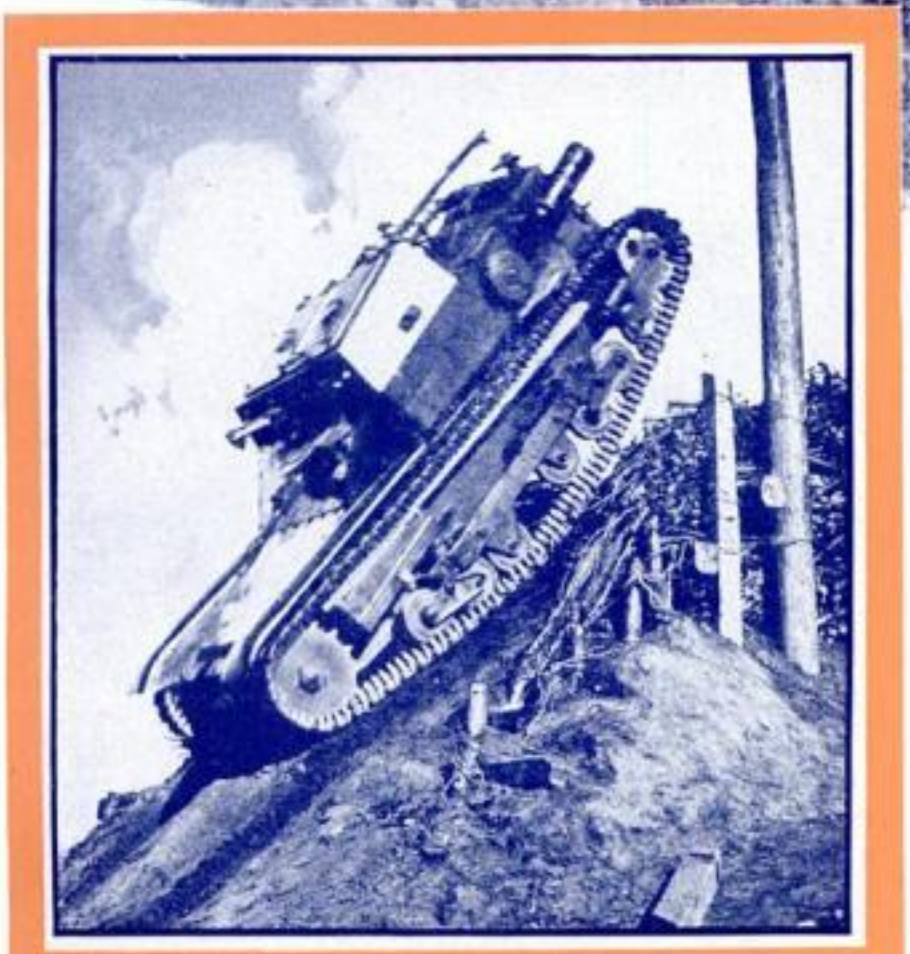
Each track number has its appropriate signal, by which it can be indicated without fear of mistake. At the left is the sign for number four. Ten, at right, is derived from the Roman numeral

This signal, meaning "Full up to here", directs the engineman to push the cars to the limit of the track

New Giant Tanks...



One of the U. S. Army's new tanks supporting an infantry advance in maneuvers which simulated war conditions



An Italian tank taking a hurdle in an obstacle race at Rome. Difficult barriers were surmounted at high speed

PEACEMAKERS OR WAR BRUTES?

Fast, Powerful Land Battleships May Speed Up the Next War by Preventing Trench Stalemates, or Even Make War an Impossibility

By

THOMAS M. JOHNSON

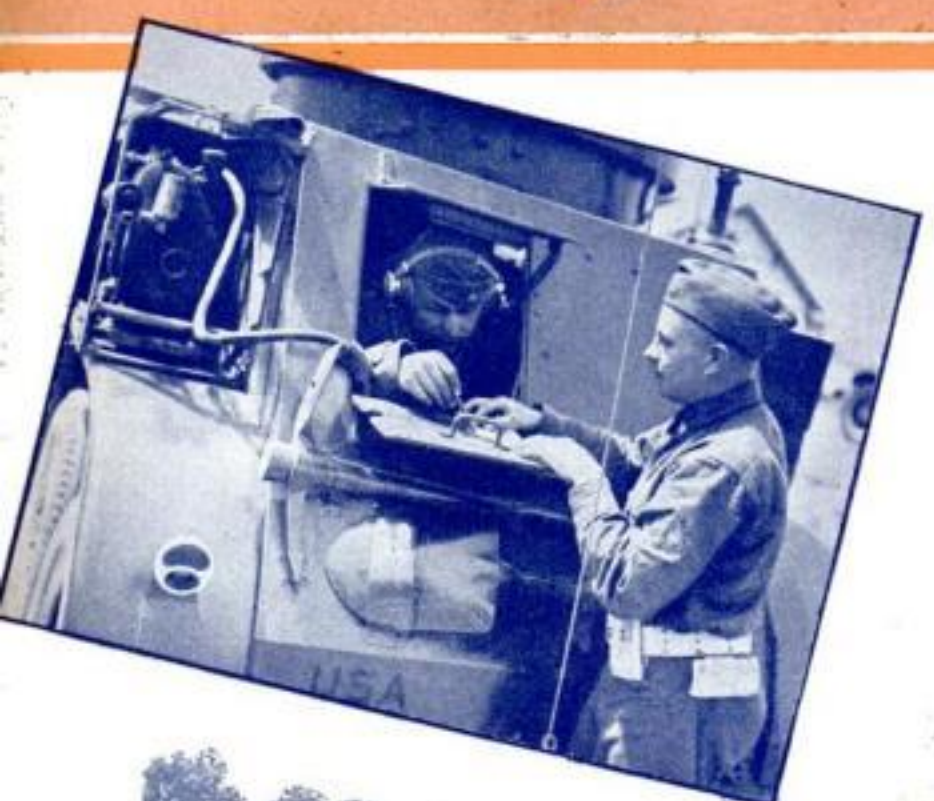
MARS has put on overalls. In carefully guarded machine shops, laboratories, and foundries all over the civilized world, the war god is tinkering with strange new machines, grimly determined to solve the mystery of that "next war" which the world dreads, but in preparation for which it spent last year nearly ten billion dollars.

The solution of that mystery, in the opinion of many experts, may end the world's dread by making an end of war itself. Is it too much to hope that invention, which in the past has merely served to multiply the instruments of death, may once more change history—this time in the role of a peacemaker? The answer may lie in the latest and most terrible of the descendants of the war chariot, the land battleship.

In the seventeen years that have passed since the end of the World War, military authorities have been concentrating their attention on that monstrous war baby, the tank. New inventions and improvements have greatly increased its effectiveness. The year 1935 is seeing the greatest development of this new arbiter of the battlefield since it first appeared upon the shell-torn fields of France in September, 1916.

Then, its dramatic entrance, its mystery, astonished the world. It, and its immediate successors, helped to break the bloody trench-warfare deadlock that had prolonged the world's most terrible war. But, once the shock of surprise wore off, World War tanks proved by no means invulnerable. They were awkward and slow, crawling on tractor treads at three or four miles an hour. They constantly stalled, from engine trouble. What a mark

Small British tanks crossing a dummy pontoon bridge constructed by Royal Engineers



A soldier of the mechanized First U. S. Cavalry receives orders by radio. This unit uses high-speed "combat cars"

Below, British tanks in a drill with smoke screens. Land battleships will use this familiar naval weapon

they presented for the enemy artillery!

Today, tanks go ten times as fast on roads, using wheels. Striking rough ground, they instantly switch to treads by dropping a ten-pound drop-forged steel rack on each side, over the wheels. With these, they can go five to ten times as fast as the World War types, crossing shell holes, ditches, and trenches.

Experimental-model tanks carrying three-inch cannon have sped 120 miles an hour, jumped thirty-five-foot gaps, and forded streams under their own power. J. Walter Christie, the American tank inventor and former automobile racer, has raced a tank against standard automobiles.

In nineteen years of research, engine designers, fuel and oil engineers, and metallurgists have made an engine lighter per horsepower, yet much more powerful, than World War tank engines. The first tank had two Daimler vertical-sleeve-valve, six-cylinder, 150-horsepower water-cooled gasoline engines. It was a poor climber, and could not spurt. These engines gave up to 5.7 horsepower per ton of tank weight. Today, one of the new Christies, with a Liberty engine, gives thirty horsepower per ton and has great reserve power.

Modern tank engines attain maximum power output at 2,000 revolutions a minute. They are usually Diesels, horizontally opposed, air-cooled, and can operate in dust. The tanks run on new-type tracks that can stand the new high speeds for 2,000 miles before they need servicing. That is due to new hard-rubber plates, improvements in steel, and heat treatment.

Such speed demons may change warfare. In 1918, the tank's greatest danger was a direct hit by a shell from a cannon, especially a swivel cannon devised to fire against tanks. These scored many hits on the slow-moving Allied tanks. But today, the new tanks go so fast and dodge so nimbly that it will take a remarkable cannon and a remarkable cannoneer to hit them. Can they be kept from getting close up to the trenches in which crouch the devoted infantry?

Straining their eyes against the smoke and gas of battle, the doughboys usually can see no farther than 1,000 yards into no man's land. Fast, modern tanks can dash that distance in, at most, two minutes. Not much time for infantry with rifles and machine guns to make a stand, before the steel monsters crush them into the mud of their trenches.

That is why Chancellor Hitler an-

Hundreds of Russian tanks assembled for a parade

nounced, no longer ago than May 27, 1935, that Germany will be armed with two fast tanks and motor vehicles to every four soldiers!

That is why, at recent Italian Army maneuvers, after Premier Mussolini had seen the remarkable performances of the new Italian tanks, he cried enthusiastically:

"The tanks have made trench warfare obsolete!"

Many military experts agree with him. They say that the great improvements in tanks, armored cars, and military motor vehicles of all kinds that are materializing today, will certainly change war greatly. They may even end the next war almost as soon as it begins, with a terrible spinning, whizzing swoop of armies on wheels and caterpillar treads, traveling at undreamed speed, hundreds of miles a day, upsetting all the precedents of strategy, ripping through hastily dug trenches. eluding artillery fire. Like a swift rapier, this mechanized force will cut through to the enemy's directing nerve centers, his headquarters, his bases. Those destroyed, he is beaten. The war is ended in days or weeks—not weary years—at small cost in lives and money.

But suppose, somehow, even these supertanks cannot get through to a vital spot on land. Then, the land battleships will take to the air! Airplanes fitted beneath with a sort of tongs, will pick up the tanks. Through the air they will carry them, to points above enemy headquarters.

Deposited on the ground, the tanks and their specially trained crews will act with accuracy impossible to aircraft. Over the headquarters telephone and radio, they will send to the enemy units, false, confusing orders. Then they will smash switchboards and transmitters, cut wires, and. at last, laden with valuable headquarters papers and prisoners, signal for their own planes to pick them up again, and wing homeward.

Only by tanks could such a blow be dealt. In Russia, experiments have already shown that a tank can be dropped by parachute from the air. J. Walter Christie expects soon to demonstrate flying tanks. He has been experimenting for years with a tank with wings that come off when it lands, and with a plane with hooks underneath that pick up a tank.

The next war will not only see tanks that fly, but tanks that swim. Christie has an amphibious tank that has swum the Hudson River near New York. Great Britain also is developing a swimming tank. This remarkable land-and-water fighting craft weighs two and a half tons, is six feet ten inches wide, six feet high, and thirteen feet long. It can speed forty miles an hour on roads, but has a flat, scowlike bottom that enables it to slide easily into the water. Driven by a propeller at the rear, and steered by a rudder, the odd craft pushes into the stream at six miles an hour, against wind and current. Like a submerged hippopotamus, it shows only its head—the round turret holding a machine gun which is fired by a gunner sitting beside the driver-pilot.

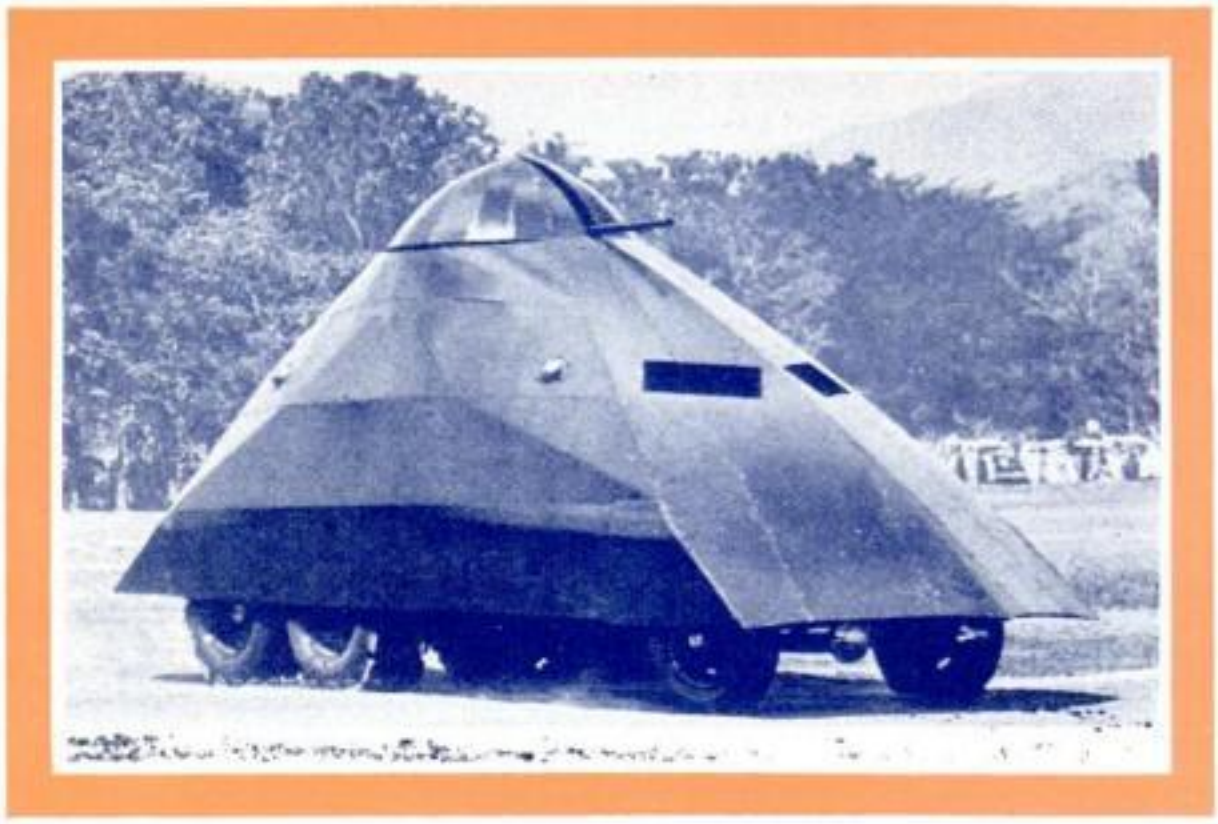
When he wants to come ashore, the driver starts his caterpillar treads, and through shallow water they help the tank wade out, boosted by the propeller. Instantly the tank dashes off at its maximum speed of forty miles an hour, and can turn around and plunge back into water again, without making adjustments. A formidable weapon to launch from ships, to make a landing on an invaded sea coast—or to defend such a coast!

Britain has blazed a trail in mechanization of her army. She has developed not only the famous Carden-Lloyd and Vickers types, but tracked machine-gun carriers and trailers, which are used in Canada also; tanks especially devised for making smoke screens, and for fighting savages. Half the British artillery is motorized, and even the cavalry dashes about in baby scout cars. Britain has 500 new tanks, and recently sent an officer to prison for five years for selling photographs of them to spies of a foreign power.

If the British believe in swimming tanks, so do the Russians. Russia has bought a hundred of Christie's American tanks, and on last May Day, seventy-five of the amphibians paraded in the Red Square of Moscow. They were part of one parade which was only one of many all over Russia; in these parades appeared, in one day, 2,730 tanks of all shapes and sizes. In Siberia are at least 500 more. In the last four years, Russia has increased her tank strength by 800 percent, and

At the right is one of the first photographs to be taken of Germany's new tank fleet, built secretly in defiance of treaty limitations. Below, a German tank that rides on a caterpillar tread of special design

in Moscow. The Red Army leads in the number of types



This Venezuelan armored car appears to have taken a cue from the native armadillo. In spite of its heavy armor, it can attain a high speed over fairly rough terrain

the speed of her tanks three to six times, Russia has more models than any other country, including "tankettes" and land battleships carrying heavy cannon. Eight of these paraded in Moscow in the May Day parade.

France claims one of the largest tanks in the world. This monster is thirty feet high, twelve feet long, and nine feet wide. It is driven by a 600-horsepower motor. It carries a seventy-five-millimeter cannon, four machine guns, and a crew of twelve men. France has 3,000 tanks, more than any other nation in the world. However, all but a few hundred are World War models, almost useless except against African tribesmen. But the new Renault and Schneider models have heavy armor, and forty percent of French artillery and practically all the cavalry are motorized. France has had less success with amphibian tanks, and cannot develop an engine that will run after fifteen minutes in the water.

ITALY worries less about tanks that swim, than about tanks that climb, for her wars would be fought on her mountainous frontiers. Recent tests showed that the new Fiat can negotiate all sorts of steep ground, rocks, even slight precipices; it can practically stand on its head, then recover, and go on. These are some of the performances that pleased Mussolini. His army has also developed a new one-ton "auto caretta" only four feet wide, with a three-foot tread, that can carry almost any weapon or munitions anywhere.

A great enthusiast for mechanization is Japan. The Japanese make their own tank, the Osaka, and are experimenting in directing it by radio, without a crew, to explode in the enemy's trenches like a land torpedo. Last winter, they tried this out on the ice of Lake Suwa. Though Japan has only a few hundred tanks, a great many of them are of modern types. But together with her enthusiasm goes a certain caution, and the Japanese is the only army that has special motorized units trained in antitank fighting.

It is not only the great powers that are interested in this newest form of war making. Bolivia bought British tanks to use in the jungles of the Chaco against Paraguay. Persia has a Christie tank. Peaceful Switzerland has more modern tanks per thousand soldiers than any other nation in the world—5.3. Then comes Poland, then Lithuania.

The dread newcomer on the tank battlefield is Germany, who but yesterday had no tanks at all. The Treaty of Versailles forbade her to have them, so she made dummies with which her soldiers drilled. Now, Germany has announced that she is building thousands of tanks, armored cars, and other motor vehicles. And it is said that she has secret plans prepared, in event of war, to turn nearly all her farm tractors into tanks in three weeks.

We might have to do something like that, if war should come to the United States today. This threatening year of 1935 finds our Army practically stripped of tanks. Today, we have in commission just twelve tanks of modern design, and many of those are experimental models. This spring, the Army quietly put into storage almost its whole supply of tanks, more than a thousand, including all the models issued to the National Guard. These were all World War models; in taking them out of commission the Army was obeying a new law that makes obsolete every Government motor vehicle built before 1920.

Our War Department has been experimenting with new models, and only recently has it really been getting anywhere. Gen. Douglas MacArthur, Chief of Staff of the Army, explains the situation thus:

"By devoting every available dollar toward the development of a satisfactory experimental model, we have finally produced single units of real promise. The latest types are capable of a sustained speed of some forty miles an hour on roads, and some twenty miles an hour across country, except on the most difficult terrain. These advances have been accompanied by equally significant ones in the reliability of the machine, and in the effectiveness and power of its armament."

How many such tanks have we? Today, only one. Some time next year we may have sixty-four really modern and efficient tanks and "combat cars," as the Cavalry call their own special brand of tanks and armored cars. "Then, and not until then," says General MacArthur, "a real beginning can be made toward the development of modern tactical doctrine as applied to them."

THERE was a hint what this "tactical doctrine" might be, recently, on the historic Revolutionary battleground of Yorktown, Va. There three tanks sped across country at twenty-two miles an hour. After them rumbled, on tractor treads, a seventy-five-millimeter cannon, self-propelled, ready to fire instantly. After this cannon came six-wheeled trucks, mounting machine guns. Into a wood they dashed, following the tanks, which crushed down underbrush and trees to make a path for them.

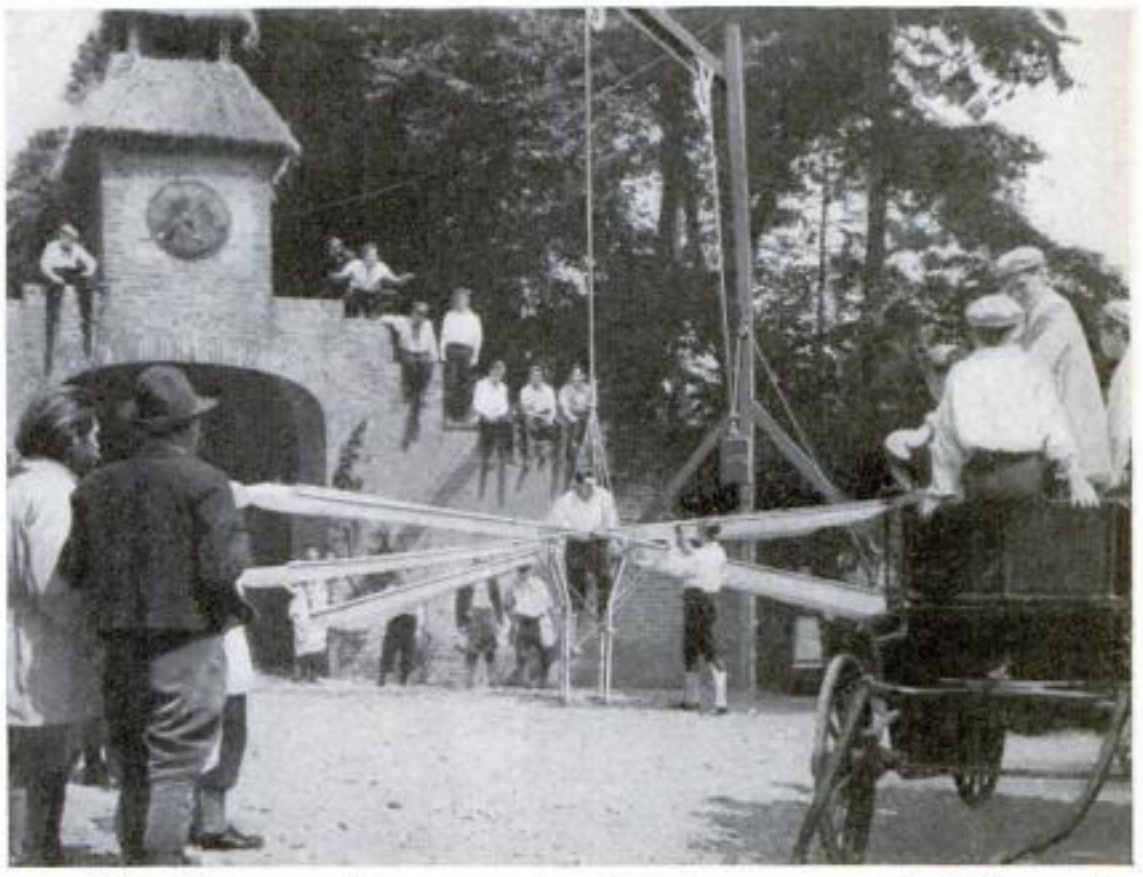
Our First Cavalry has turned its horsemen into mechanics, testing out new armored cars which differ from tanks in that they have wheels only, not treads, and so cannot readily *(Continued on page 114)*

Many nations are experimenting with amphibian tanks

MUFFLER AT TARGET RANGE TRAPS NOISE OF GUNS

REDUCING the sharp crack of firearms to a dull thump like the sound of pounding on a heavy box, a new target-range muffler makes pistol and rifle practice easier on the ears of the participants and of others in the vicinity. The user fires through a chamber, open at each end, as shown in the cut-away view above. A sound-absorbing lining of balsam wool covered with perforated metal, shown in the inset, traps the noise. According to the maker, the muffler offers no handicap to marksmanship. By eliminating the glare on the front sight, it permits the range to be adequately lighted. Two sizes are available, the smaller one suited to small-caliber pistols and rifles in basement ranges or those of small clubs, and the larger model to guns of any caliber.

MOVIE SHOWS CONQUEST OF THE AIR



Otto Lilienthal's unsuccessful attempt to fly with flapping wings, as reënacted for movie

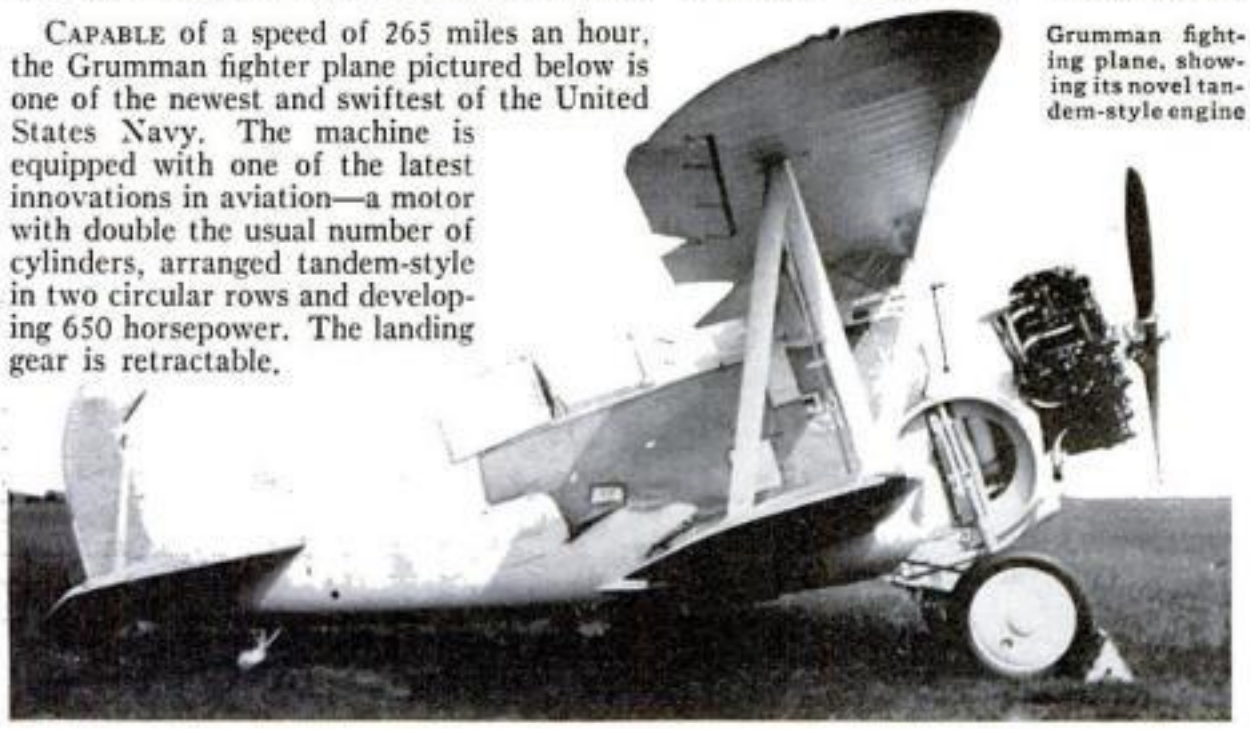
STIRRING episodes in the history of man's conquest of the air are being reënacted for a movie in England. The odd scene reproduced above shows the filming of one of the earliest and least-known experiments of Otto Lilienthal, German pioneer. Seeking to fly by flapping wings, he built this curious machine in 1868, and tested its lifting power by hanging it and a counterweight from a boom attached to a barn. The experiment was a failure, since he found that by the utmost exertion he could lift only half his weight. Turning aside from the flapping-wing idea, he devoted himself to the historic gliding experiments for which he is famous, and which helped pave the way for the eventual success of heavier-than-air machines.

THREE-WHEELED SKATES HAVE RUBBER TREADS

RUBBER-COVERED balls of fiber replace steel wheels in roller skates of new design. The three-wheeled skates are said not to mar floors or carpets, and to be virtually silent. According to the maker, they require no lubrication, and are lighter in weight than ordinary steel skates. The illustration shows the standard size and also a smaller model, with front wheels set well forward to prevent overbalancing, intended for the use of very young children.

ODD MOTOR POWERS FAST NAVY PLANE

CAPABLE of a speed of 265 miles an hour, the Grumman fighter plane pictured below is one of the newest and swiftest of the United States Navy. The machine is equipped with one of the latest innovations in aviation—a motor with double the usual number of cylinders, arranged tandem-style in two circular rows and developing 650 horsepower. The landing gear is retractable.



Grumman fighting plane, showing its novel tandem-style engine

At left, the lock open to receive the oars. Below, oars held securely by new device

INGENIOUS LOCK BALKS PILFERING OF OARS

OARS cannot be taken away without the owner's permission, when they are protected with a lock that has been devised by a California inventor. A pivoted cross member, attached to a brass yoke, swings aside so that the oars may be inserted. When the cross member is turned back and made fast with a padlock, the oars are secured against unauthorized use. The device may be securely bolted to a wharf, a boathouse, or the stern of a rowboat, as illustrated in the picture above.

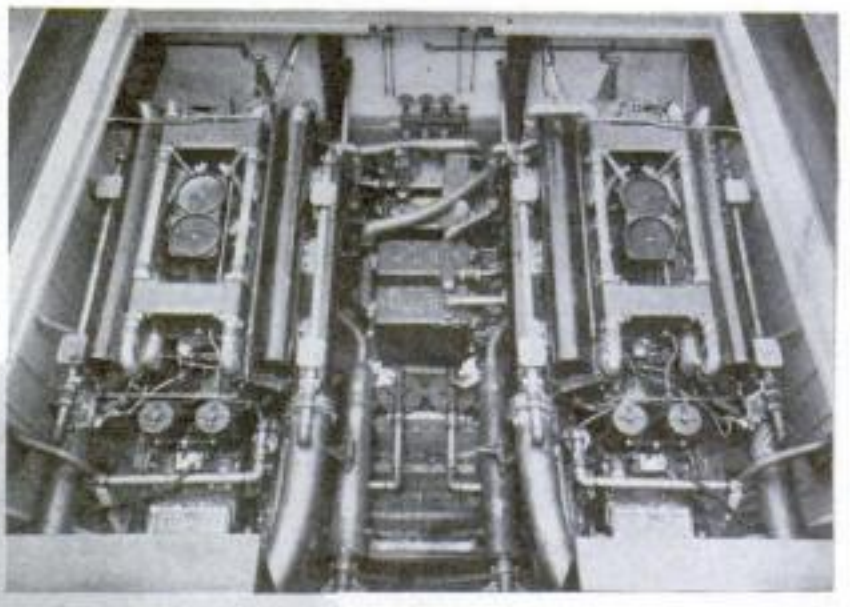
HAIRLESS MICE MAY GIVE CLEW TO BALDNESS CURE

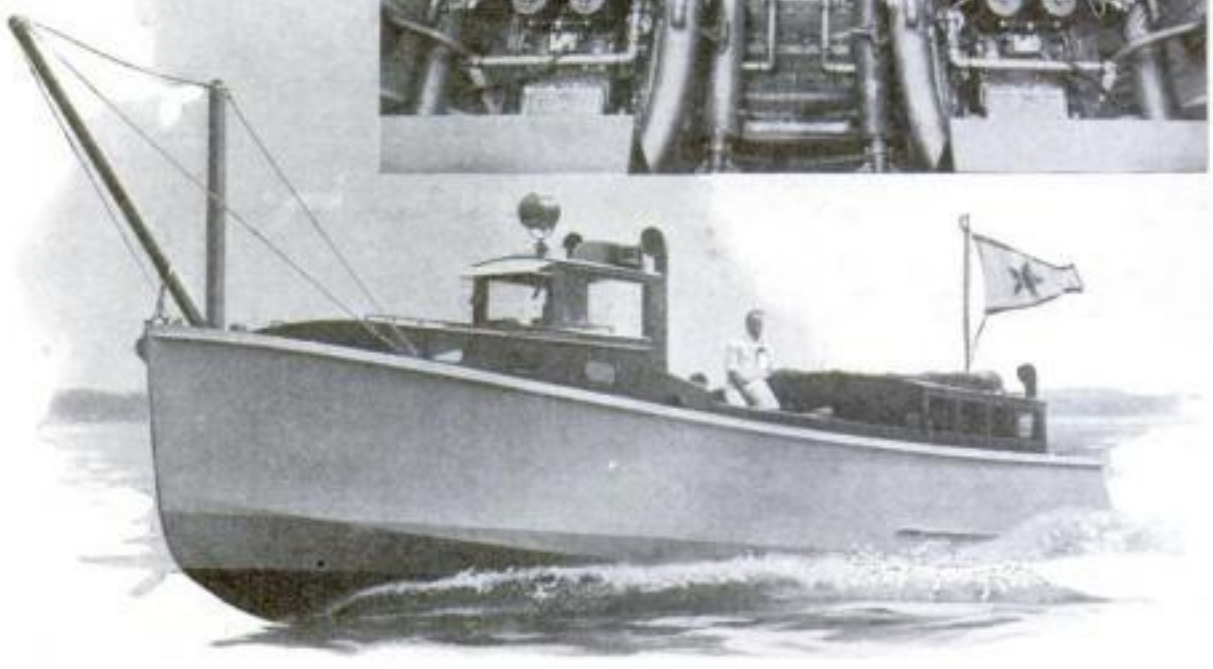
JUST arrived in this country, a shipment of African "rhinoceros mice" may help scientists to find the cause of baldness and develop a cure. Although the strange rodents have whiskers like other mice, their bodies are devoid of hair. Experiments to determine the cause of this unusual characteristic are planned by Dr. Alexis Carrel of the Rockefeller Institute and Dr. W. E. Cassell of Harvard University. If the experimenters should succeed in growing hair on the mice, as reports indicate they may attempt, it is hoped that a similar treatment may be worked out which will cure baldness in human beings. Two of the mice are seen in the picture above.

FAST BOAT SPEEDS AIR-CRASH RESCUES

Two twelve-cylinder motors, each developing 650 horsepower, give the new "crash boat" its phenomenal speed

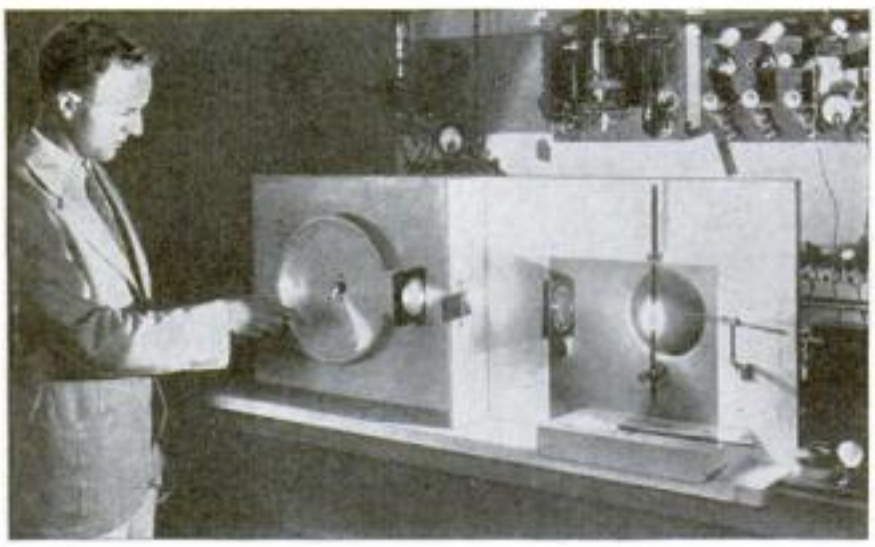
Manned by a crew of six, the craft is designed primarily to make quick rescues of personnel in cases of crashes by naval training planes





DECLARED the fastest craft in the service, a fifty-mile-an-hour "crash boat" is under trial by the U. S. Navy. Its mission is to speed to a training plane that has crashed into the sea, rescuing the men and salvaging the plane if possible. Two twelve-cylinder motors developing 650 horsepower apiece drive the forty-five-foot racer, and six men, including a doctor and assistant, constitute the crew.

CAMERA SHOWS ARC IS HOTTER THAN SUN



New camera which measures arc's heat by photographing sound wave

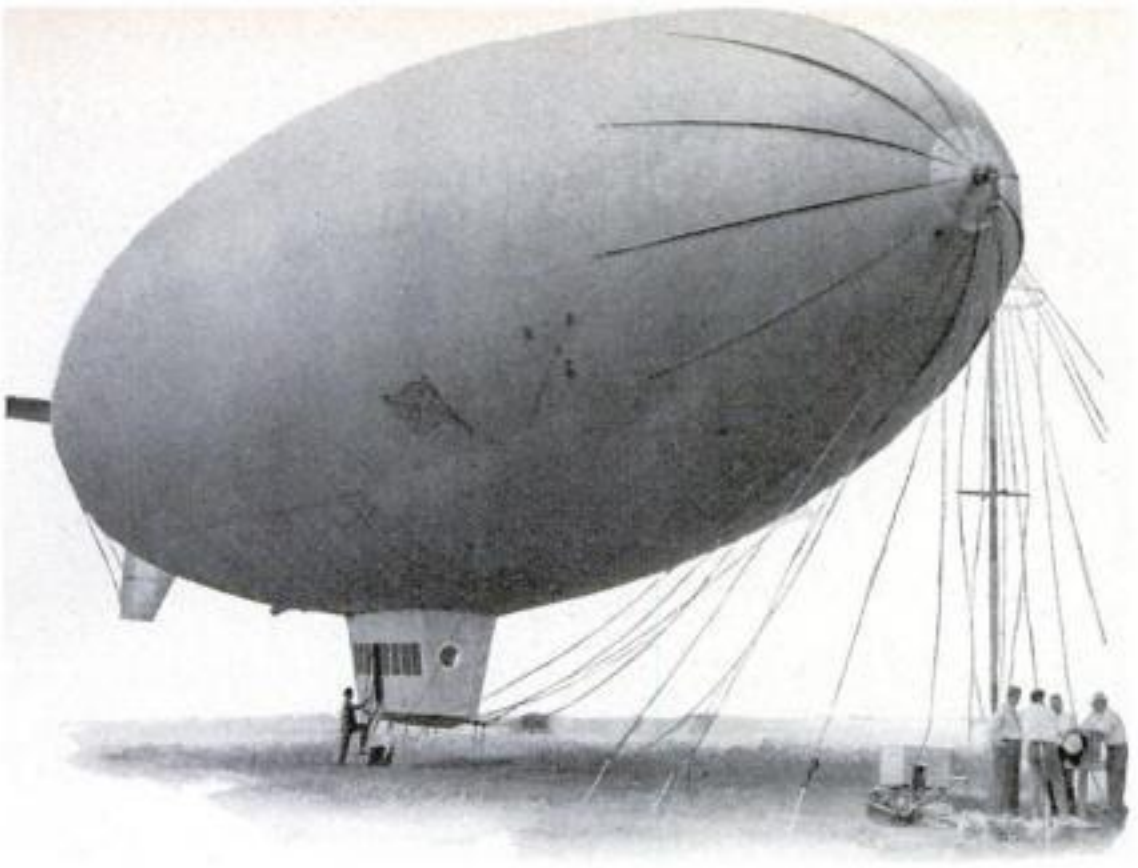
FIRST accurate measurements of electric-arc temperatures show that carbon arcs used in lighting exceed the sun's surface temperature of 9,000 degrees F., and some welding arcs reach 13,000 degrees. Applying the fact that sound travels faster through a hot gas than a cool one, General Electric engineers used a special camera to time the passage of a sound wave, set up by a loud spark, through the arc.

COMPRESSED AIR REPLACES DYNAMITE FOR MINING

COMPRESSED air replaces dynamite in a new method of coal mining, through which dangerous fumes are eliminated and the coal is recovered in larger and more valuable chunks than heretofore. A long steel cartridge is thrust into a drill hole in the face of the coal deposit, as at right, and is charged with air to a pressure of 15,000 pounds to the square inch. When the miners have retreated to a safe distance, a valve suddenly releases the charge. Expanding, the air heaves out the coal in large fragments, without shattering it. The cartridges may be used over and over again.

ROOMY TELEPHONE BOOTH HAS NOVEL APPOINTMENTS

ACCUSTOMED to the cramped quarters of an ordinary telephone booth, an American would be taken aback at the roominess and appointments of a new style of booth introduced in London, England. Patrons may avail themselves of a luggage shelf, a mirror, an umbrella stand, and a cigarette tray, while large signs give telephone rates and explain the intricacies of dialing for the benefit of the uninitiated.



DUMMY AIRSHIP TESTS NEW MOORING METHODS

BUILT from discarded parts of other airships, a motorless blimp that was never intended to fly is helping engineers at Akron, Ohio, to solve mooring problems of lighter-than-air craft. The photograph above shows the helium-filled bag during a test of a new type of mast. Stresses are measured with instruments attached to guy cables. Other dials record weather data.

CLOCK KEEPS MORE ACCURATE TIME THAN THE EARTH

A CLOCK that keeps better time than the earth itself is a mechanical marvel soon to be installed at the Greenwich Observatory in England. Astronomers gauge time by the speed of the earth's rotation, as shown by the passage of stars across the sky, but this varies slightly. In a year's time the earth may be a full second "fast" or "slow." The new clock will not gain or lose more than a quarter of a second yearly, permitting a check on the earth as a timekeeper.

One of two clocks to be run by new precision timepiece

SPARK PLUG KILLS CAR RADIO NOISES

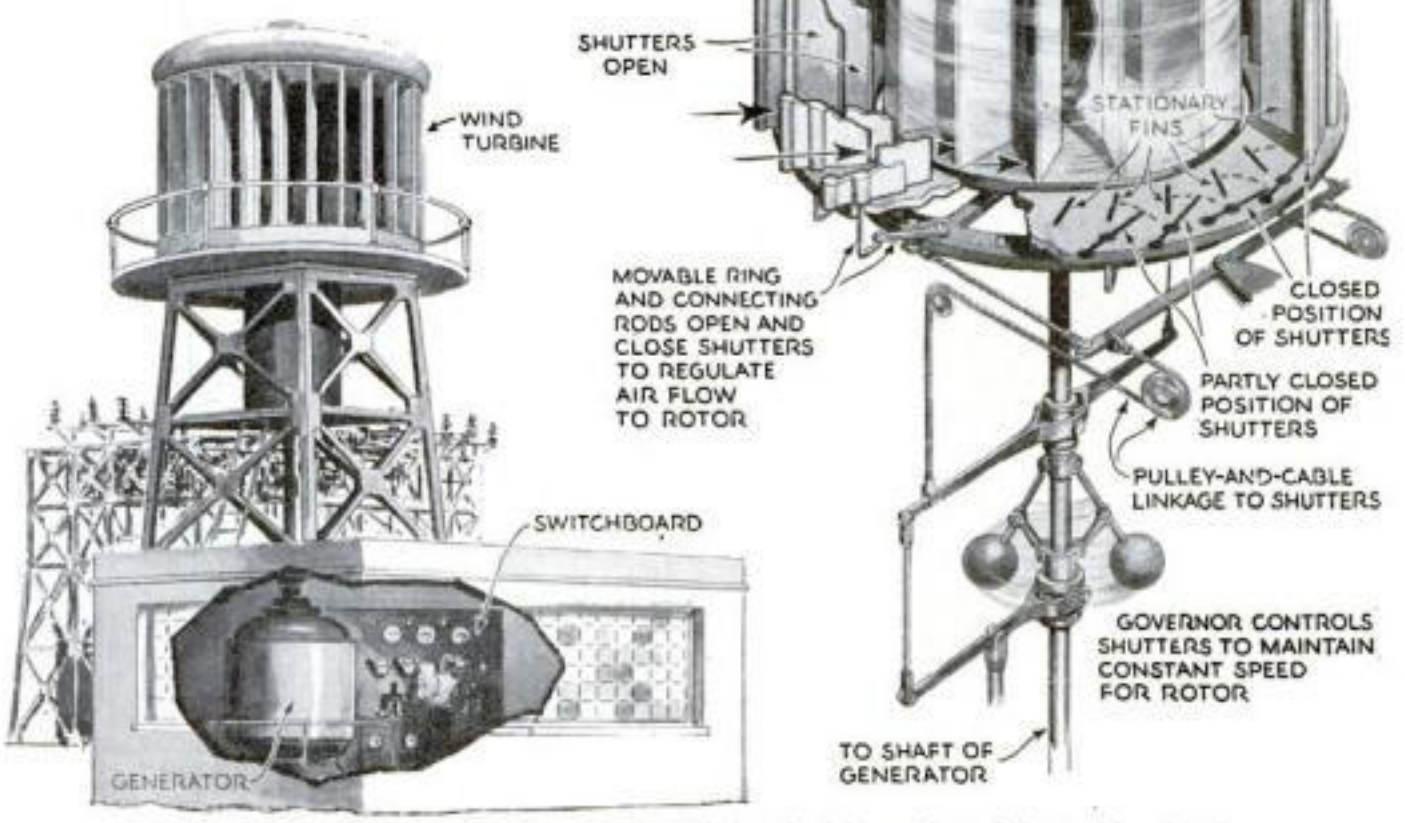
SPARK plugs of a new type, for cars equipped with radio, are designed to suppress annoying interference caused by the ignition system. Each plug contains a resistor, built into the insulator, which is said to reduce clicks and other noises to a minimum. The photograph above shows one of the new plugs cut away to reveal its construction; the resistor, indicated by the pencil, is readily removable and may be replaced whenever necessary without buying a new plug.

ODD USE FOR GOLD

COMPLICATED apparatus used in certain chemical manufacturing processes is made throughout of fine gold. The costly metal is used because of its resistance to attack by acids and other strong chemicals.

WINDMILL OPERATES LIKE A TURBINE

A WINDMILL patterned after a steam turbine is a Kansas City, Mo., inventor's contribution to the search for a practical large-scale means of harnessing breezes for power. His "wind turbine" consists of a multi-bladed rotor, set upon a tower so that it may spin on its vertical axis, and enclosed in a housing with stationary guiding fins. The fins direct the air stream toward the vanes of the rotor at the most efficient angle, and power is generated by a dynamo coupled to the same shaft as the whirling rotor. So that the electrical output will not fluctuate, the inventor provides an ingenious governor that automatically opens or closes shutters on the rotor housing, admitting more or less air, as needed, to maintain a constant rotor speed. The accompanying diagrams explain the principle of the wind turbine and show how it would appear from the exterior when installed in connection with a plant for the generating of electric power.



The wind turbine as it would appear installed and, right, a view of the turbine details

FLYERS PHOTOGRAPH FAIR BY NIGHT

To DEMONSTRATE recent advances in aerial photography at night, and improvements in the equipment for such work, Army flyers recently snapped a flash-light photo of the exposition grounds at San Diego, Calif., from a height of 1,500 feet. Such small details as pedestrians and moving automobiles on the walks and drives were clearly visible in the original picture from which the accompanying reproduction was made, showing that large-scale troop movements under cover of darkness, relied upon for secrecy in the World War, no longer can be hidden from flying photographers. Illumination for the San Diego picture was furnished by the explosion of huge "bombs" of flash-light powder dropped from the plane as it sped over the exposition grounds.

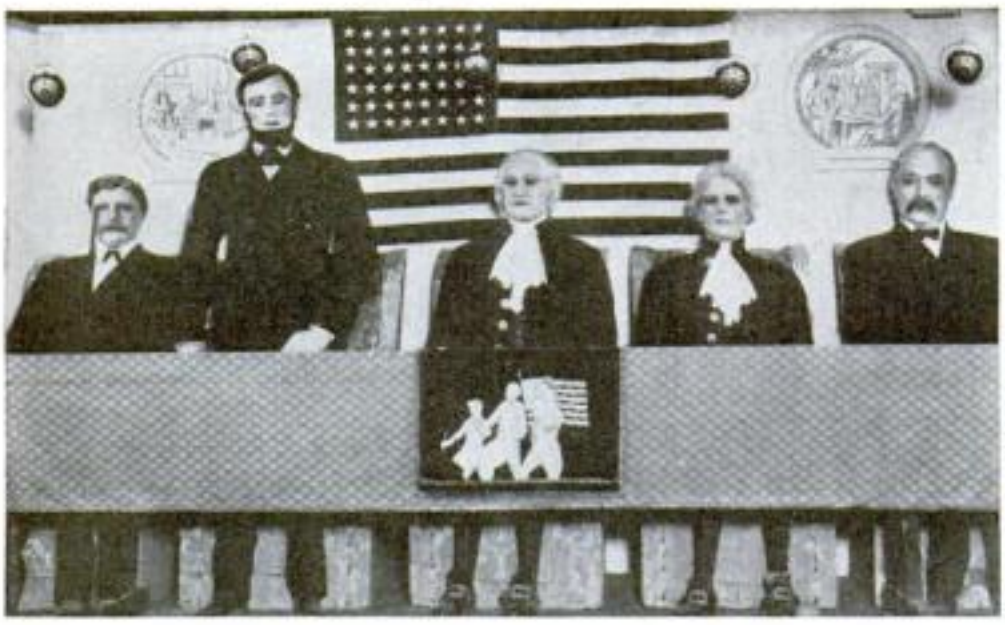
Camera and new-type flash-light bombs used by Army flyers to take night views

The view of the San Diego Exposition at left was taken from 1,500 feet at 9:30 P.M.

When opened, this cigarette case discloses a midget radio receiver

TINY RADIO BUILT IN CIGARETTE CASE

A RADIO built into a cigarette case was a novelty exhibited at a recent British radio exposition. The miniature receiver employs a single tube —one of the smallest in the world— and has a pair of midget tuning dials. Only half the thickness of the case is occupied by the set, ample room remaining for about a dozen cigarettes. The radio is turned on or off by means of a knob at the outer edge of the case, which is shown open in the accompanying photograph to reveal the compact units of the midget receiver.



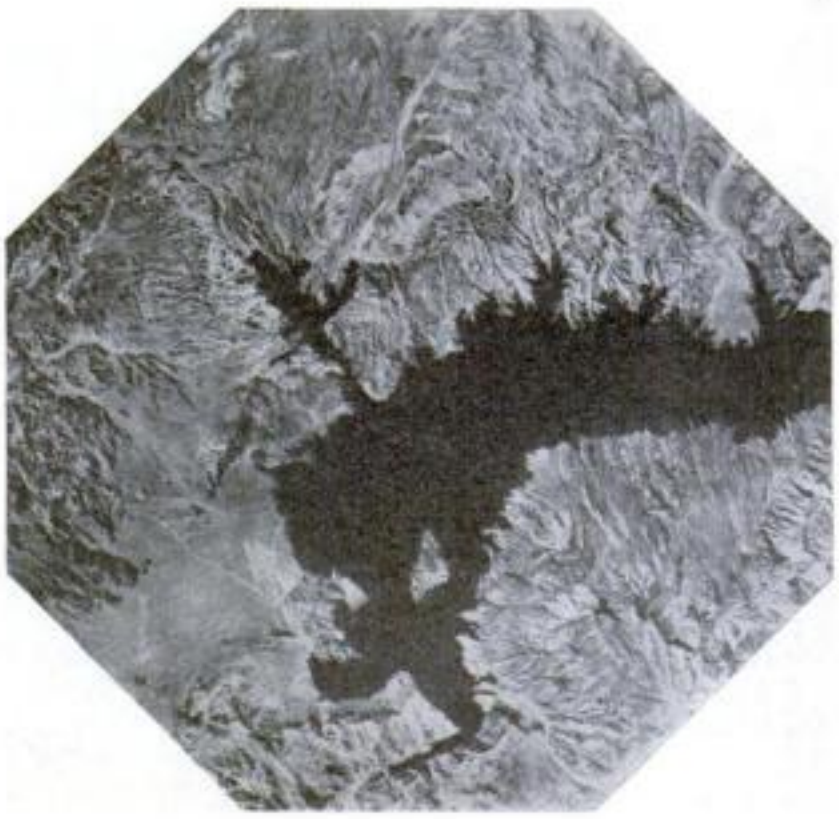
PAST PRESIDENTS "TALK" IN EXHIBIT

The figures of the presidents, upper view, are moved by back-stage levers and phonograph records talk for them

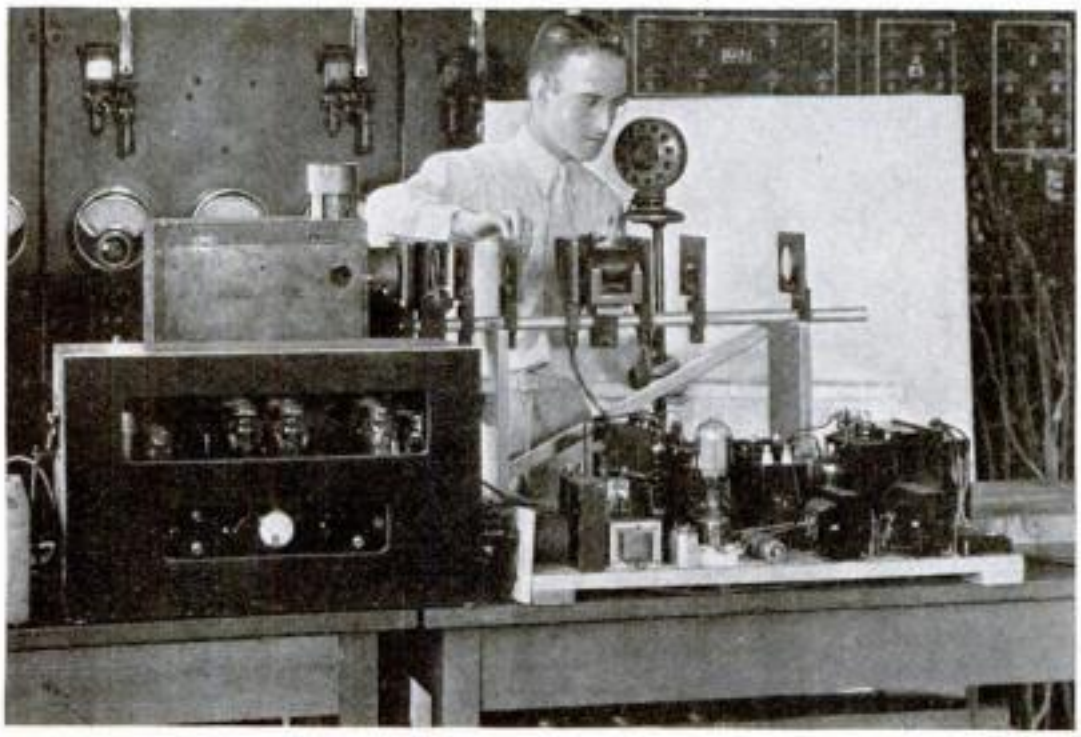
FIVE of our most famous presidents come to life in a unique historical exhibit designed by a New York inventor for display in stores and schools. Under the control of an operator off-stage, figures representing Theodore Roosevelt, Abraham Lincoln, George Washington, Thomas Jefferson, and Grover Cleveland rise in turn and deliver excerpts from some of their most famous speeches. Levers like those in a signal tower raise and seat the figures, and the voices are supplied by sixteen-inch phonograph records and reproduced by loudspeakers hidden behind the stage. Dummy microphones give the exhibit a modern touch, suggesting that these former chief executives might have assembled to take part in a present-day meeting.

GREAT WEIGHT OF BOULDER DAM MAY DENT EARTH'S CRUST

LIKE a stepped-upon air mattress, the surface of the earth will be pushed in by the weight of Boulder Dam and the Colorado River waters it impounds, if the view of the earth as a thin, flexible crust floating upon a plastic interior mass is correct. Tests of the theory are made possible, for the first time, by the unprecedented magnitude of this concentrated load, the weight of the lake alone being estimated as 41,500,000,000 tons. Beneath this burden, according to the theorists, an area of 150 square miles should sag as much as two feet. Surveyors' bench marks will be used by Government scientists to determine if this is so. The remarkable air view below shows the vast extent of the lake impounded by the dam.



Amateur Transmits Sound on Light Rays



Junior Howard and the transmitter of his apparatus for sending sound over light rays

PARALLELING experiments of professional research workers, Junior Howard, twenty-one-year-old graduate engineering student of Kansas State College, has built apparatus of his own design to transmit speech and music on a ray of light. The beam of an arc lamp, modulated by a Kerr cell and polarizing prisms, is picked up by electric eyes at the receiving end and the sounds are reproduced in a loudspeaker, or in headphones. Hiding the receiver in a professor's home, a quarter-mile distant, Howard surprised him with an unexpected musical program.

Four lenses, in receiver at right, collect the light rays and focus them on four photo-electric cells, which convert them into electric impulses for sound reproduction

COMPRESSED AIR RAISES PAINTER'S SCAFFOLD

BY MANIPULATING air valves of a new pneumatic safety stage, a painter may roll the platform on which he stands up and down the side of a building. Rubber-tired wheels prevent marring the walls. The telescopic supporting column is extended or lowered by air pressure, supplied either from storage tanks or from a portable air compressor, and may be moved sideways along the wall on a second pair of wheels at its base. Use of the new device is said to save time by eliminating the trouble of adjusting ropes, as with a hanging platform.

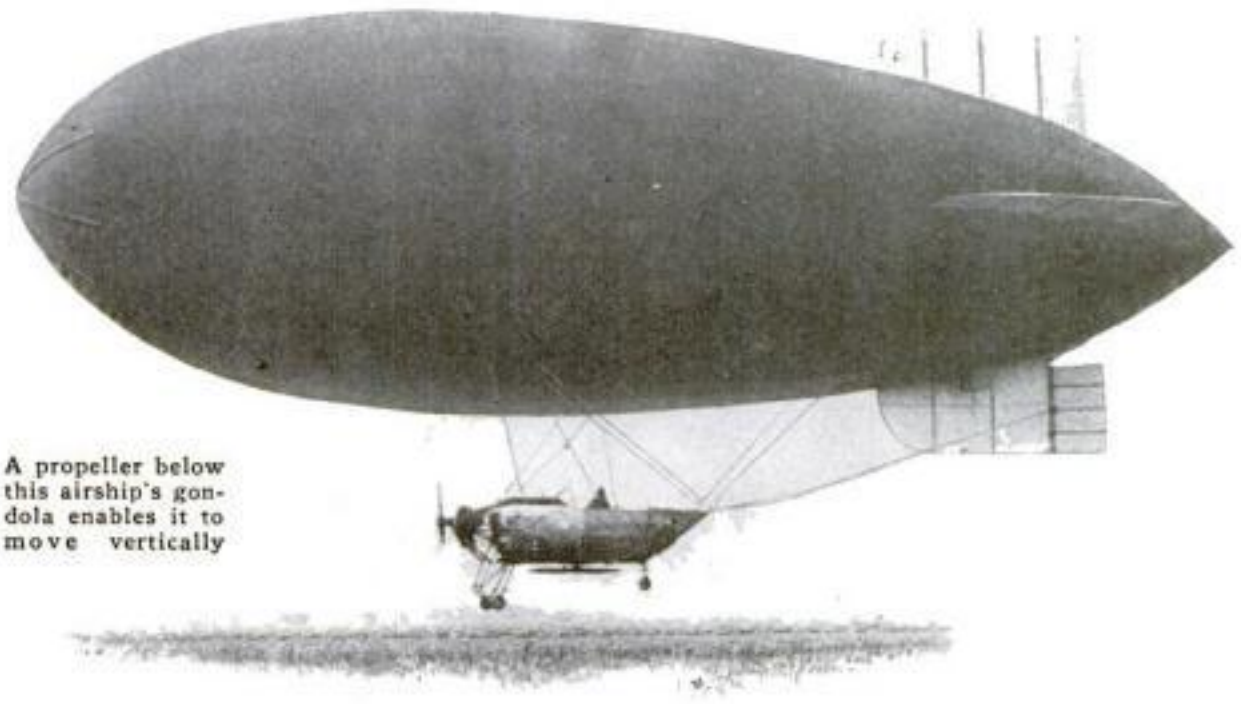
This new scaffold is raised or lowered on a telescopic column operated by compressed air

ERASURE GUARD ENDS CARBON-COPY BLURS

HANDY for typists, a new erasing shield facilitates correcting errors without smudging a carbon copy. When its metal tongue is slipped between a letter and a carbon sheet, and an aperture plate is slid into position on a frame above the letter, a neat erasure is easily made. The device may be applied from either side of the paper, and apertures of assorted sizes permit one or more erasures to be made at a time. The accompanying photograph shows the shield in position and the manner in which it is used.

PROPELLER MOVES AIRSHIP VERTICALLY

A FOUR-BLADED propeller mounted beneath the gondola of a new French dirigible enables it to maneuver vertically like a helicopter, ascending without dropping ballast and coming down without valving gas. Forward propulsion, at speeds up to fifty miles an hour, is provided by a second, conventional propeller. The two air screws have individual power plants of fifteen and sixty horsepower, respectively.



A propeller below this airship's gondola enables it to move vertically

No Place Like Home

...TO GET HURT

While sitting on his front porch, a Kansas farmer was knocked out of his chair when a passing car flipped a rock at him

YOU face 266 times the danger of injury while reading a book at home, walking down the cellar stairs, or thawing a frozen pipe, that your neighbor does when he embarks on the evening plane for a distant city.

Unbelievable? At the risk of boring you, I shall prove my statement with a few figures.

This year, if the nation's experience of former years holds true, fully 5,184,500 of our 125,000,000 men, women, and children will suffer accidents—from falling out of chairs to slipping down icy stairs—in their homes. Of the 561,370 or more passengers riding in transport airplanes, for a total distance of 49,000,000 miles, not more than 357 will be involved in seventy-three accidents, and only eighty-eight will receive so much as a scratch.

One in twenty-four will be hurt at home, whereas only one in 6,378 will meet an accident on an airliner!

Suppose, however, your neighbor roars away from the neighborhood airport with a barnstorming pilot or a friend who flies for fun. Will he come home whole or in pieces? The surprising number of 1,397,288 passengers flew 75,602,152 miles in private planes last year, and only 2,711 were involved in 1,549 accidents. Of these a mere handful—786—were hurt. Half this small total sustained bruises only. So, if you decide to try your wings with a friendly pilot in your town, you'll be seventy-four times safer than at home.

Queer accidents, usually under circumstances that promise safety to the victims, strike down people everywhere. Serious at the moment, many of these strange incidents which, despite the intervention of science and education, increase in numbers every year, bring chuckles when viewed from the apparent safety of your own arm chair.

Let's skim around the country for a close-up view of some of the oddest. In the Northwest a truck driver, arriving home after a dangerous day piloting his machine over streets deep in snow, tried to open a window swollen tight. When, after several efforts, the window flew up, the man fell off balance and dived three stories into a bank of snow. A housewife in Gary, Ind., slipped on a cake of soap while bathing, ricocheted through a window, and plunged three stories into a pile of sand, receiving only minor bruises to attest her unusual experience. Not to be outdone by this feat, Mrs. Evelyn Stewart lost her balance and fell five stories from the balcony of her New York apartment—only to land in snow piled high along the curb. Little Bobby Isbel of Morrisville, N. Y., celebrating his third birthday by playing with a new knife, fell out of his chair. The three-inch blade penetrated his skull above one eye to the hilt, yet the youngster recovered.

While painting an elevator shaft, James Parnell, an aged Brooklyn, N. Y., workman, tumbled from a ladder, clutched a starting cable and was pinned between car and wall for nineteen hours before Charles Somerville "had a hunch" something was wrong inside the building and went to his rescue. A few days later, Arthur Thomkin, a youth living in the same neighborhood, slid down a dumbwaiter rope to save walking down four flights of stairs. The rope parted and dropped him onto the basement floor; he broke both legs and fractured his skull. Possibly, he would have met a worse fate had he walked. One man, ascending a flight of iron stairs, fell when a step broke, and hanged himself from the skeletonlike superstructure.

Every week, miraculous hair-breadth escapes from death are recorded. A Kansas farmer was knocked out of his chair on his front porch when a speeding car flipped a rock against the side of his head. In Los Angeles, Calif., a youth lighted a cigarette while trying to take himself out of this world with gas, and the resulting explosion saved his life by blowing him out through a wall. An eleven-year-old boy, warned to avoid traffic with his bicycle, chose to ride the vehicle on the roof of an apartment house. He rode off the edge and landed in a police-station yard forty feet below, suffering only a bruised thumb.

Not all escape so luckily. Often, simple mistakes end in death. When basement water pipes froze on a cold winter night, a sixty-year-old retired builder, whose life had been spent constructing houses, applied a gasoline blowtorch to the problem. But the supposed water pipes led to his gas stove—and the resulting explosion ended his life.

You never know whose carelessness will endanger your household. One of forty-eight youngsters living in a Charlotte, N. C., home for children mischievously turned on the gas in the kitchen. A pet parrot, perched near the stove flew to the superintendent, screaming, "Come! Come!" The superintendent followed the bird back to the stove and shut off the escaping gas.

A boy rode his bicycle off a roof and landed in a court forty feet below, almost unhurt

Dumb creatures are popularly supposed to give warning of threatened danger, but they do not always live up to this reputation. Eight trained chimpanzees were asphyxiated by coal gas when a chimney became clogged with soot, and only a two-hour siege by a Brooklyn, N. Y., inhalator squad saved them. A coffee pot boiled over

Mishaps Cost Uncle Sam More Than $5,000,000,000 a Year

Accidents took a toll of 101,000 lives in the United States last year. The 9,821,000 disabling injuries suffered by Americans in the same period cost $2,400,000,000 in medical expense, insurance, and loss of wages. Property damage, including buildings razed by accidental fires, reached the staggering total of $3,500,000,000.

More than half of the accidents reported occurred in the home. Estimates based on past experience indicate that 5,184,500 persons, in this country alone, will be injured in household mishaps this year. Twice as many will meet accidental death at home as will succumb from accidents of all kinds while at work.

The most important causes of fatalities at home are falls and burns. Nearly half of the falls occur in bedrooms, a majority of the burns in kitchens. More people die from slipping on floors, rugs, and stairs, falling while getting in or out of bed, or while sitting down in or getting up from chairs, than from all other home causes.

By Andrew R. Boone

and doused the flames of a gas stove in the apartment where a woman lived with six pet snakes. Both the mistress and reptiles were unconscious when neighbors broke in and carried them to safety.

Not infrequently, it is the rescuer who finds himself injured, while the person or animal in danger escapes. Mrs. Sarah Nelson leaped through the window of her third-story New York apartment when an oil stove exploded, setting fire to the room. John Mobley, who happened to be passing, saw her as she flung herself into space, braced his body, and broke her fall. The impact sprained his back, while she was able to walk away without help.

From eleven in the morning until nine at night, a cat mewed mournfully from a tree in Brooklyn, N. Y. As the hour of curfew rang, Walter Fournays, a chauffeur, climbed the tree, took the kitten under his arm and prepared to bring it down to safety. A small branch broke under Fournay's weight and he fell fifteen feet, fracturing his skull on the sidewalk. The cat landed safely.

A Chicago policeman, answering a call from frantic mothers, shot himself in the leg while trying to bring down a stray dog which had been snapping at children. Undaunted by the self-inflicted wound, he killed the animal with the second shot.

Of course, not all the odd accidents happen at or near home. With the suddenness of thunder, they occur unexpectedly anywhere. Too, many result from carefully laid plans to avoid injury while performing a dangerous job or hasty attempts to escape from impending tragedy.

Two-hundred-pound William Philupe, New York baker, turned out the fire under one of his bake ovens one Friday night. On Monday morning, thinking it had cooled sufficiently for him to enter to repair a faulty grate, he crawled into the narrow brick-lined fire box only to discover that heat from an adjoining compartment had shot the temperature up to 350 degrees. In an effort to back out quickly, the baker became tightly wedged. Unable to pull Philupe out, his employer called police, whose rescue squad demolished the steel door and brick masonry by means of acetylene torches and iron bars. Thirty minutes later, suffering first-degree burns, the victim was lifted from the oven.

Sailors on the French destroyer *Ouragan* fired several practice torpedoes which raced through the Atlantic true to their marks and exploded. They then slipped into a tube a new torpedo to test its range. The projectile leaped into the sea, swiftly turned in a circle, crashed into the ship near the stern. Had the defective gyroscope which governed its direction been placed in one of those containing high explosives, the *Ouragan* today would be rusting on the bottom of the ocean.

Scott Kline, manager of an electric company at Wilkes-Barre, Pa., faced imminent electrocution for thirty minutes not long ago under bizarre circumstances. He was replacing a safety fuse governing a powerful current when a bushing cracked, loosing a 13,000-volt current which set up a powerful magnetic field. Kline fell to the floor and, unable to move, suffered a series of shocks. He was a prisoner of electrically induced magnetism a full half hour, until a helper arrived and turned off the current. Yet he received no burns.

After facing death while washing a window on the sixteenth floor of a skyscraper, Michael Karp fractured his ankle during a self-rescue. Karp had finished cleaning the window and unfastened one end of his safety belt, when he slipped off the narrow ledge. In his frantic efforts to crawl back up to safety he cracked his ankle.

Explosions, from toy gas balloons to tons of powder, bring injury to many under strange circumstances and in odd places. A large crowd at Hamilton Fish Park, New York, gathered to hear a speech by Mayor LaGuardia, was thrown into a near panic when two dozen gas-filled balloons, carried by Morris Berebaum, exploded and burned five people, including two babies. How they were set off no one knows, unless by a lighted cigarette, touched accidentally or purposely to one of the spheres.

But to get back to the home—at Bordeaux, France, an entire family was engaged in a mouse hunt when the mother shoved a hot poker back of the kitchen sink hoping to force a mouse out into the open. The hot metal touched a quantity of explosives stored there by her husband. The blast blew out one side of the kitchen and injured all six in the family.

In Tennessee, a home accident not only resulted in the house burning to the ground, but also touched off twenty cases of dynamite and 250 kegs of blasting powder stored next door, which destroyed fifty homes and buildings. Isadore Overman, New York junk dealer, tossed one of a shipment of old shells in a fire to determine whether they were loaded. His question was answered when a large piece of metal embedded itself in his thigh. Flying chips broke windows in houses as far distant as three blocks.

Where are you safest—rocking in your favorite chair, sitting at your work desk, in a theater, wading in shallow ocean surf, or standing in *(Continued on page 116)*

Slipping on a cake of soap while bathing, an Indiana woman plunged through a third-story window. A pile of sand broke her fall and she escaped with only minor bruises

In another freak accident, a locomotive engineer was knocked out by a six-pound pheasant which flew in through his window

$10,000 Mink Coats

A male mink raised on a back-yard fur farm. This animal won a prize at a show held by breeders

Skins of Uniform Quality And Beauty Grown under Artificial Conditions in Profitable New Industry

By

Walter E. Burton

This baby mink was born in captivity

OF THE 250,000 mink pelts that reached the American fur market last year, one in every five came from an animal grown in captivity. Many were produced at midget farms established in out-of-the-way corners.

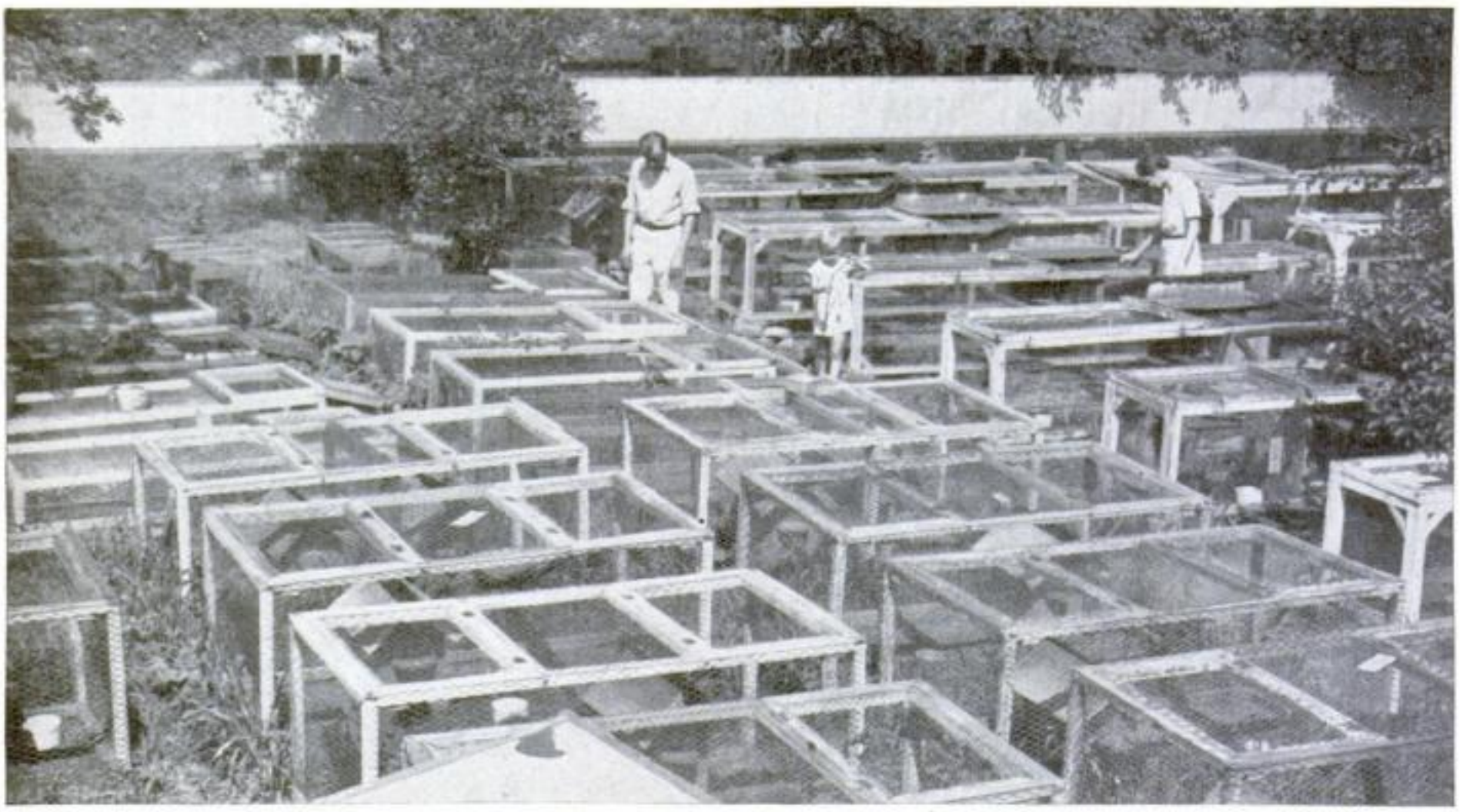
Typical of the back-yard fur farms which have appeared in many parts of the country is one maintained by Michael Haska on the outskirts of Akron, Ohio.

Seven years ago, Haska bought a pair of breeding mink for $200. Now, he has 100 pens and more than 400 animals in his wire-enclosed back yard. The litters range from two to ten pups, the average being five. Animals born in May are ready for market the following November and their pelts bring from five to thirty dollars apiece.

The cost of raising a single mink is approximately a dollar a year. Its food consists mostly of meat with a little grain and vegetables thrown in. Haska uses a mixture of fish and beef. He gets his fish from a local market in the form of scraps and bones. When horse meat is available, it is satisfactory for feeding the animals. Young mink are fed twice a day; grown-up ones only once, in the evening.

Related to the weasel and about the size of a small cat, the mink is one of the hardiest of the fur-bearing animals. The mortality rate at Haska's one-man farm is about two animals lost for every hundred raised.

The pens are wooden frames with chicken wire nailed to all six sides. It is necessary to have the wire extend over the bottom to keep the animals from digging their way out. Inside the cages are the little houses



Occupying the back of a city lot, the mink farm shown above houses more than 400 animals. The cages are tagged to provide breeding records

Raised *on* Back-Yard Farms

where the mink sleep. Watering crocks complete the equipment. Recently, Haska has added a number of new-type pens which have the sleeping quarters attached to the outside to make the work of cleaning them easier.

Surrounding the yard is a high woven-wire fence having a wide strip of galvanized iron at the top. This prevents the mink, if they escape from the pens, from climbing over the fence to freedom. When a few of the animals escaped before the fence was built, most of them hung about the mink farm until Haska caught them in special box traps baited with food.

All the animals have white spots or patches under their chins. These are to mink what fingerprints are to humans. No two spots are exactly alike. At one time, these patches were used as distinguishing marks in registering the animals.

The color of mink fur varies from light brown to almost jet black, the latter being the most valuable. The size, curiously enough, has little to do with the value of a skin. According to Haska, the characteristics which make a pelt valuable are dark color, silky texture, and dense underfur.

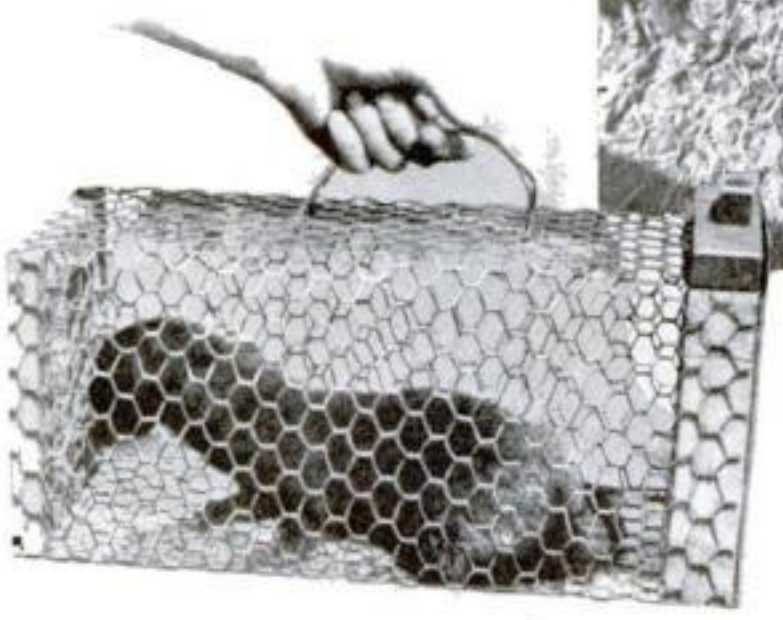
The average mink coat contains from sixty to eighty skins. Yet, it will weigh only about four pounds. Priced at from $3,000 to $10,000 apiece, such coats cost as much as $2,500 a pound or approximately $160 an ounce! However, with good care, the garments will look like new after half a dozen years of use. It is the combination of lightness and warmth that gives mink fur its great value as a material for making coats.

In making a coat, an expert matches the pelts for color and texture. Sometimes, he will go over as many as 10,000 skins to find sixty that can be placed together. Increasing the difficulty of this work is the fact that pelts coming in from trappers all over the United States and Canada vary according to the locality. Now, with an increasing proportion of skins coming from fur farms, where the breeding stock is standardized, the work of the experts promises to be easier.

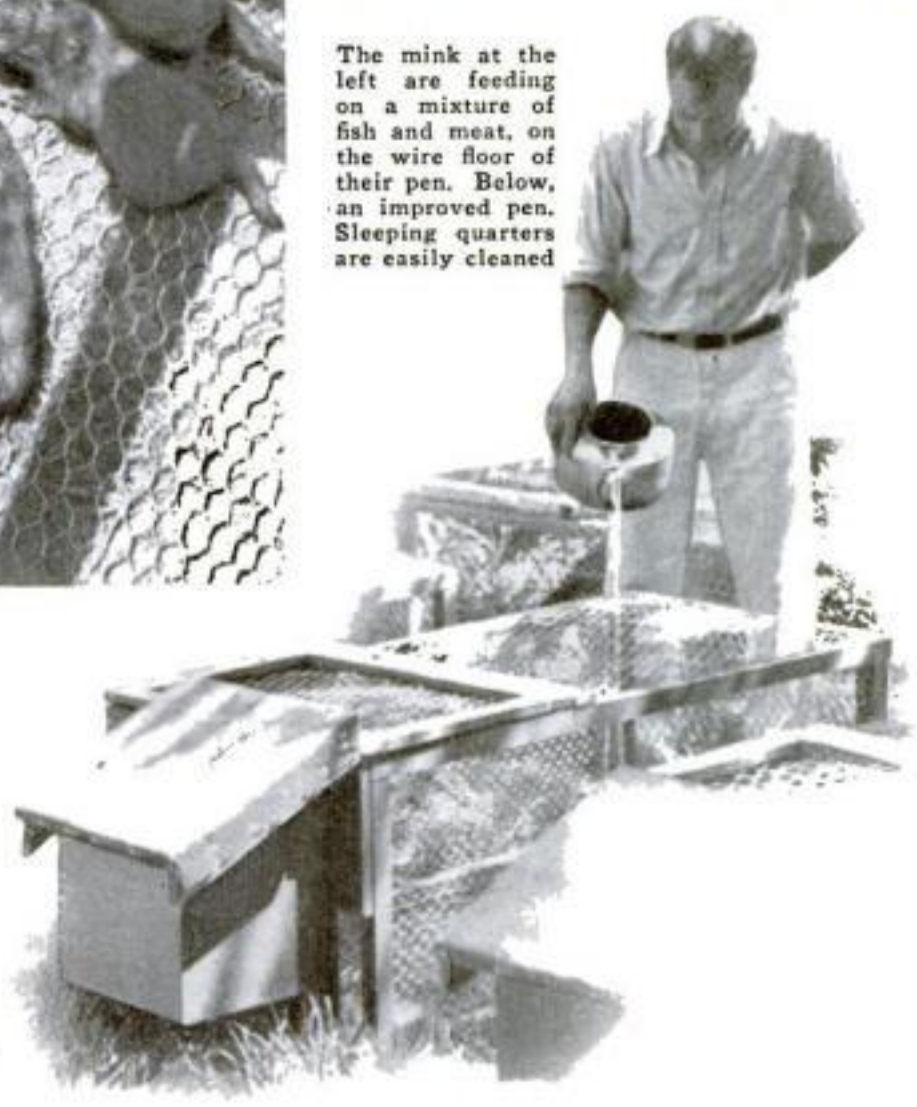
Two kinds of mink are commonly bred in captivity. One is the type familiar in the eastern part of the United States; the other is from the Yukon country of Canada and Alaska. The latter is the largest and its fur is used for chokers and trimmings, while the pelts of the smaller American mink go into the body of the coat.

Last year, Haska entered some of his animals in the annual show sponsored by the Ohio Fox Breeders Association. One captured the cup for the "Grand Champion Mink" and another won the title of "Pup Champion" of the exhibition. In all, his back-yard products carried off twelve ribbons and a silver cup.

Michael Haska, fur-farm operator of Akron, Ohio, examining one of his valuable charges. Haska uses heavy leather gloves to protect his hands from the sharp teeth of unruly animals

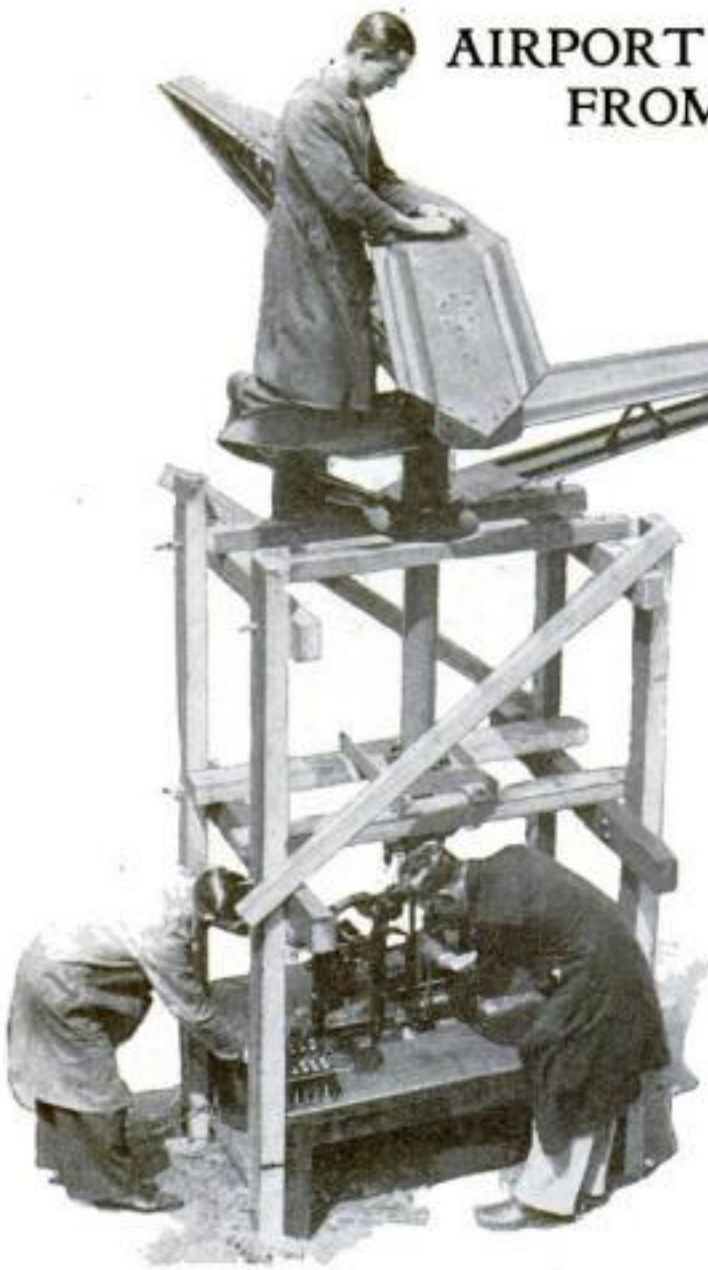


A portable box trap used for recapturing mink that escape from their pens. The entire farm is now surrounded by a high woven-wire fence which has a wide strip of galvanized iron at the top



The mink at the left are feeding on a mixture of fish and meat, on the wire floor of their pen. Below, an improved pen. Sleeping quarters are easily cleaned

AIRPORT CLOCK VISIBLE FROM 3,000 FEET



MASSIVE enough to serve as perches for workmen are the hands of a giant clock destined for the new Rand Airport in South Africa, and shown as it appeared while under construction. It will enable airmen flying as high as 3,000 feet overhead to read the time. The face, thirty feet in diameter, will be level with the surface of the earth, and the mechanism that runs the hands will be operated by electricity and be housed underground. The minute hand is seventeen feet long and the hour hand fourteen and one half feet. The huge clock is patterned after a similar giant timepiece that has proved a practical innovation since it was installed recently at an airport near London, England.

MOVE DATE PALM FOUR MILES IN BIG TRANSPLANTING JOB

A SEVENTY-FOOT date palm, sole survivor of twenty-one that were brought from Morocco to San Diego, Calif., more than half a century ago, recently went for a four-mile ride across the city. Set up by a derrick at its new site, as shown above, it constitutes one of the biggest transplanting jobs of its kind. A hole thirty feet in diameter and fourteen feet deep had to be dug for the roots.

TINY BULB ILLUMINATES POLICE BADGE AT NIGHT

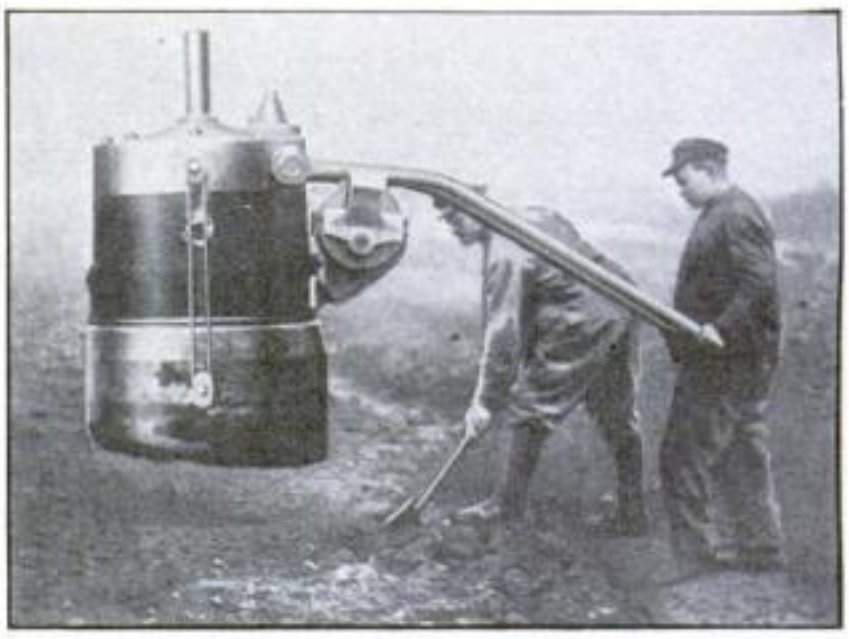
SO THAT railroad police assigned to yard duty may readily identify themselves after dark, an illuminated badge has been introduced. Flash-light cells mounted on the back of the badge provide current to light a small bulb when the user presses a switch as shown in the photograph above.

BLOTTER SHORTENS LIFE OF INK IN SIGNATURES

BLOTTERS should never be used to dry signatures on important legal documents and state papers, according to the U. S. Bureau of Standards, since removing the greater part of the ink will shorten the life of the writing. When signatures are required to remain legible for many years, as in all papers that are valuable as matters of record, the ink should be allowed to soak into the paper and dry there.

SOIL TAMPER HOPS UNDER OWN POWER

A "JUMPING-JACK" soil tamper that leaps up and down under its own power has been developed in Germany to speed road construction. Explosions of gasoline in a cylinder project the device upward, and the heavy impact of the falling machine stamps the earth as forcibly as a steam roller. Since the cylinder is tilted forward, the machine moves in a series of short, froglike hops, requiring only slight guidance from the operator through a pair of long handles resembling those of a wheelbarrow.



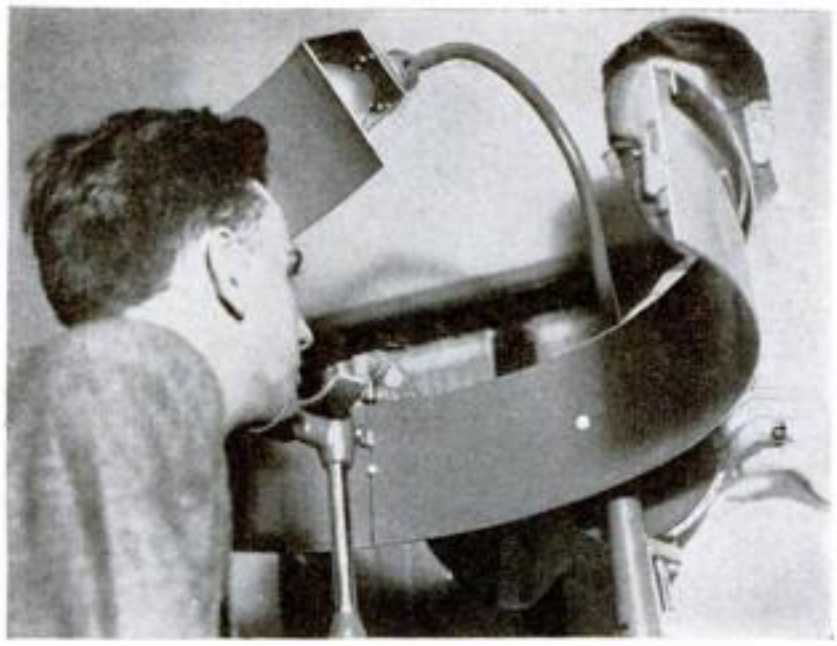
Using its own power, this jumping tamper speeds up road building

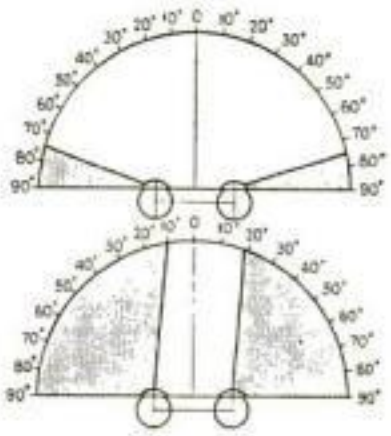
Flexible celluloid engraving glued to wood block

MAY MAKE ENGRAVING PLATES OF CELLULOID

ENGRAVING on celluloid is said to be made a possibility by a recently tested process, intended to provide a substitute for the copper plates ordinarily used in printing illustrations. After the celluloid has been etched by a special chemical process, it is mounted on a wood block in the customary way except that glue is used instead of tacks. Cut blocks are therefore usable to the extreme edge, requiring no "shoulder." The hardness of the material is reported to enable it to stand up well under long press runs, a single cut yielding as many as 100,000 satisfactory impressions.

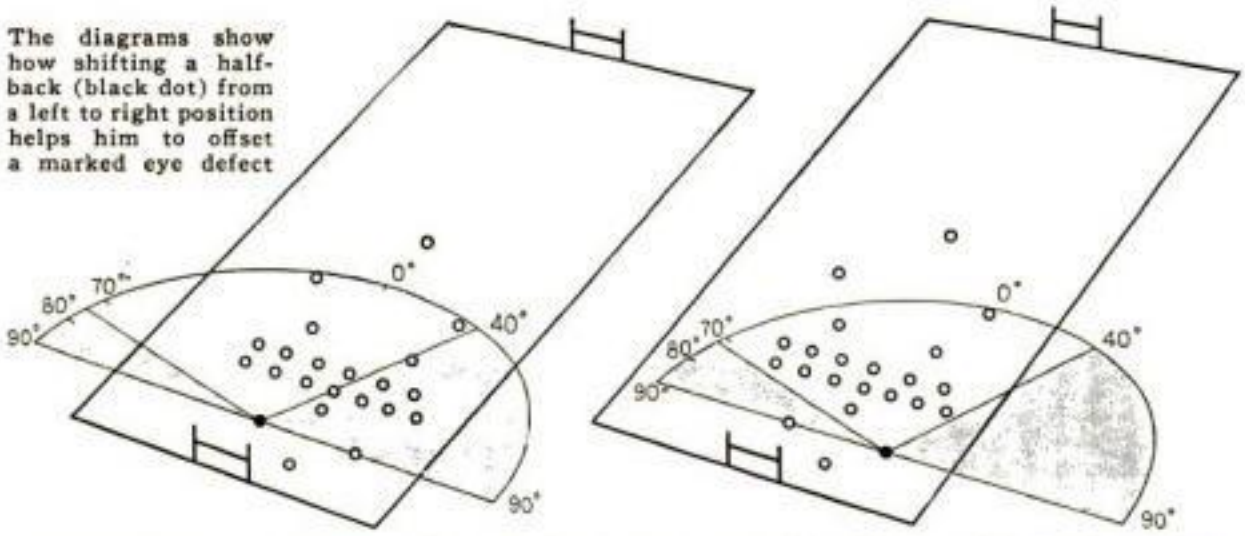
EYE TESTER HELPS PICK FOOTBALL TEAM





These charts are made in vision tests by the machine at the left. The top one is that of normal eyes. In the lower chart, an extreme case of "tunnel" vision is shown

WHEN a halfback on the University of California varsity football team persistently failed to dodge opposing tackles, the coach didn't take him off the squad. Instead, he sent him to the laboratory of the team's eye consultant, Dr. A. R. Reinke. By shifting colored targets along a curved track until they disappeared from the player's view, the examiner discovered that he could see practically nothing out of the tail of his right eye. On the doctor's recommendation, the coach shifted the player to the right side of the line, where his good left eye enabled him to make a stellar record. Similar tests for all football players have now been instituted by the university, where they are proving of vital importance to football strategy. Normal persons, while looking straight ahead, can still see objects approaching from either side, but a temporary infection or permanent eye defects may limit some persons to a range of vision within a few degrees of the direct line of sight. A sufferer from "tunnel" or "pinhole" vision, as this defect is known, may not even realize it, since his eyesight for reading or in conventional eye tests seems perfect, but he may unknowingly be a menace at the wheel of an automobile or a liability to his team while playing on the football field.



The diagrams show how shifting a halfback (black dot) from a left to right position helps him to offset a marked eye defect

LEVER REPLACES PULLEY IN SIMPLE CHAIN HOIST

COSTING a fraction of the price of a conventional chain hoist, a simplified new type for garages, farms, and factories employs an ingenious lifting principle. When the handle is pumped up and down, claws on a casting attached to it alternately engage opposite sides of a loop of chain, causing the load to climb the chain. Safety projections on the casting prevent the load from slipping or dropping accidentally. Any length of ordinary three-quarter-inch pipe may be used as an extension handle for the hoist, which is designed to lift loads up to half a ton.

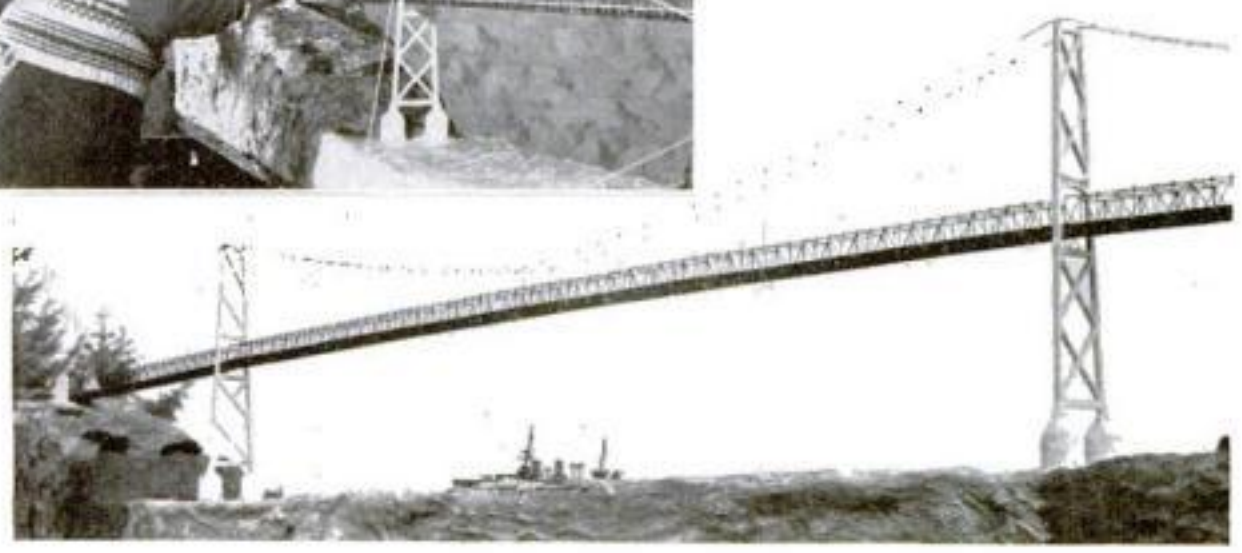
HOT ROOF OF ATMOSPHERE

RECENT experiments indicate that an intensely heated layer, hitherto unknown to science, may encircle the earth's atmosphere. Tests with radio waves place its height at 150 miles and its temperature at 1,700 degrees F.

BUILDS REMARKABLE SCALE MODEL OF SUSPENSION BRIDGE

FROM brass wire, thread, and plaster, R. S. Robbins, of Vancouver, Canada, has constructed so realistic a model of a bridge projected to span the city's harbor entrance that in a photograph it might be mistaken for the real thing. To make a scale model of the 1,500-foot suspension span, he cut each piece of wire to the required length, placed them on a flat surface, and soldered them in place. Miniature scenery placed at the approaches, and a model ship riding on plaster water beneath the bridge, add to the realism of the bridge proper which gives the illusion in pictures that it is the actual span at the entrance to the harbor of Vancouver, British Columbia, Canada. The model required four months of work. The prototype of this model will have a main span of 1,500 feet supported by towers 800 feet high. The center of the span will have a clearance of 200 feet at high tide.

The picture below is not that of a real bridge but of a model made of brass wire, thread, and plaster. The builder, at left, required four months to make the countless cutting and soldering operations



Student Creates Cave of Magic in Cellar

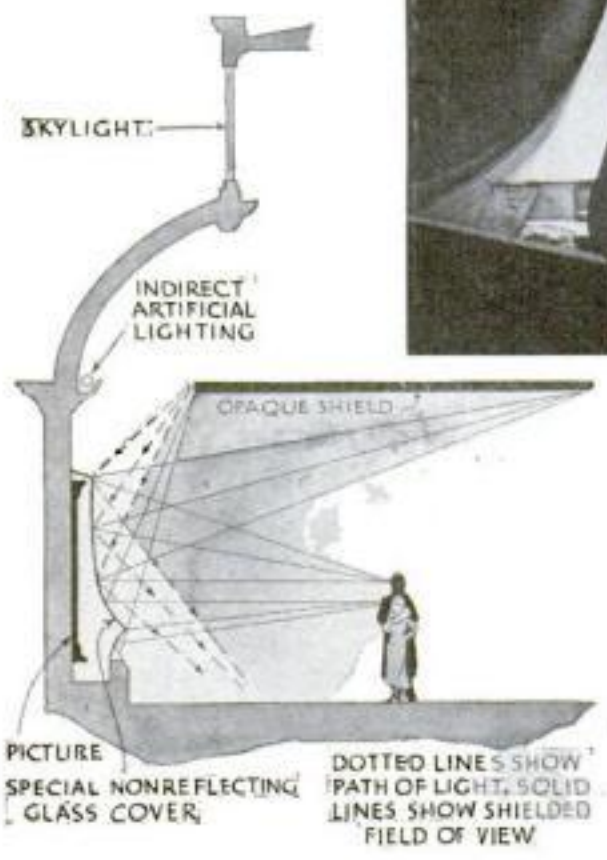
A remarkable theater-workshop has been built by John Schall, Jr., in the cellar of his home. There marionettes perform, as at left, and chemical experiments are carried on (below). The switchboard (right) controls weird lighting so devised by Schall, disposes of waste water and, by solving the problem of using running water below the level of street drains, makes it unnecessary for him to carry pails of water up and down stairs. An elaborate switchboard controls the lighting effects and the motor-driven apparatus.

A secret panel in the laboratory wall admits the visitor to a black-draped chamber rigged up as a theater for performances of magic. Here, as Schall wields a wand, colored streamers of ribbon appear from seemingly empty boxes, cards do baffling tricks, and marionettes perform upon a midget stage illuminated by working, reduced-scale models of spotlights and flood lights. An organ, reclaimed from the junk pile and put in working order, furnishes music during a performance. It also provides special sound effects to heighten the dramatic effect of a program.

IN A SUBTERRANEAN retreat that he has built in the cellar of his home, John H. Schall, Jr., twenty-three-year-old medical student of Brooklyn, N. Y., pursues his spare-time hobbies of magic and chemistry. Colored lights and ingenious theatrical effects, devised for the entertainment of his friends, provide a setting suited to represent an imaginary meeting place of alchemists and sorcerers.

Through a coffin-shaped entrance, guarded by a skull with flashing green eyes, a visitor steps into a dimly lit "alchemist's workshop" where an arched grotto, housing microscope, retorts, and graduates, is bathed in blue light from a hidden source. The grotto is not for show alone; at the touch of a switch, bright lights transform its table into a practical microscope bench, while surrounding wall shelves bespeak a well-equipped chemical laboratory. A homemade ventilating system exhausts noxious vapors from an experiment cabinet; and an electrical pumping system, al-

CURVED GLASS COVERS FOR ART ELIMINATE REFLECTIONS

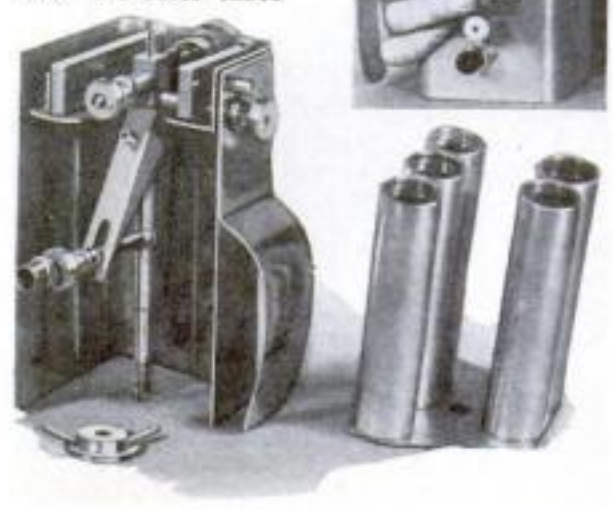


OBJECTIONABLE reflections on glass-covered pictures, detracting from the enjoyment of visitors to art museums, may be banished by a scheme already applied successfully to show windows. When a window front is curved as in the photo above, so that a dark ceiling is the only thing reflected, the glass becomes virtually invisible to the onlooker. Similar arrangements suited to the display of pictures in art galleries were described recently before the Royal Society of Arts, in England. One of the proposed methods is shown in the diagram at left.

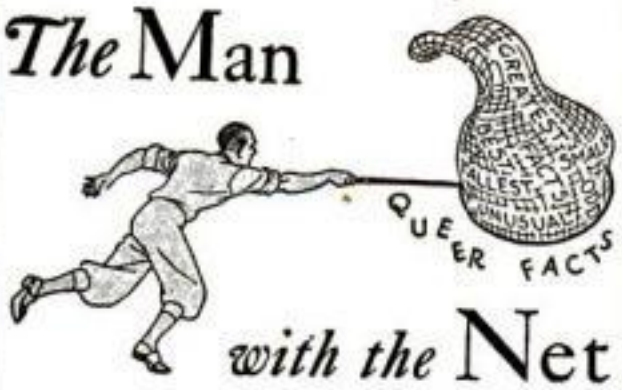
PAINT GUN SPRAYS FIVE DIFFERENT COLORS

SPRAYING any desired tint is made easy by a multi-colored paint gun, invented by a French engineer. Any one of five colors, contained in individual cups, may be used at will by pressing a corresponding button. To mix colors, two or more buttons are pressed at once. Compressed air operates the device as in conventional single-color spray guns.

The spray gun at right carries five colors which are released by pressing the proper buttons. To mix colors, two buttons are operated. Below, the gun has been dismantled to show the color tubes



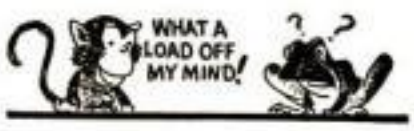
The Man *with the* Net



JAMES WATT *designed a steam engine which is still pumping water in England. One hundred and twenty-one years old, it was built before the battle of Waterloo.*

CRICKET FIGHTS *are popular sporting events on the Island of Bali.*

FROGS, *rather than apes, were our remote ancestors, according to a new theory of evolution advanced by a Swedish scientist.*



PARROT FISH *of Bermuda can bite through an ordinary fishhook.*

EVERY *five seconds, on the average, an American goes to a hospital.*

WHITE TEACHERS *are instructing Indians at a New York reservation in the art of making flint arrowheads.*

BLOODSHOT *glass eyes are made by a western firm for users who want both eyes to match on the morning after the night before.*

RUBBER PLATES *are now used in printing books.*

RARE OCEAN FISH *are being collected from the stomachs of larger fish by French ichthyologists.*

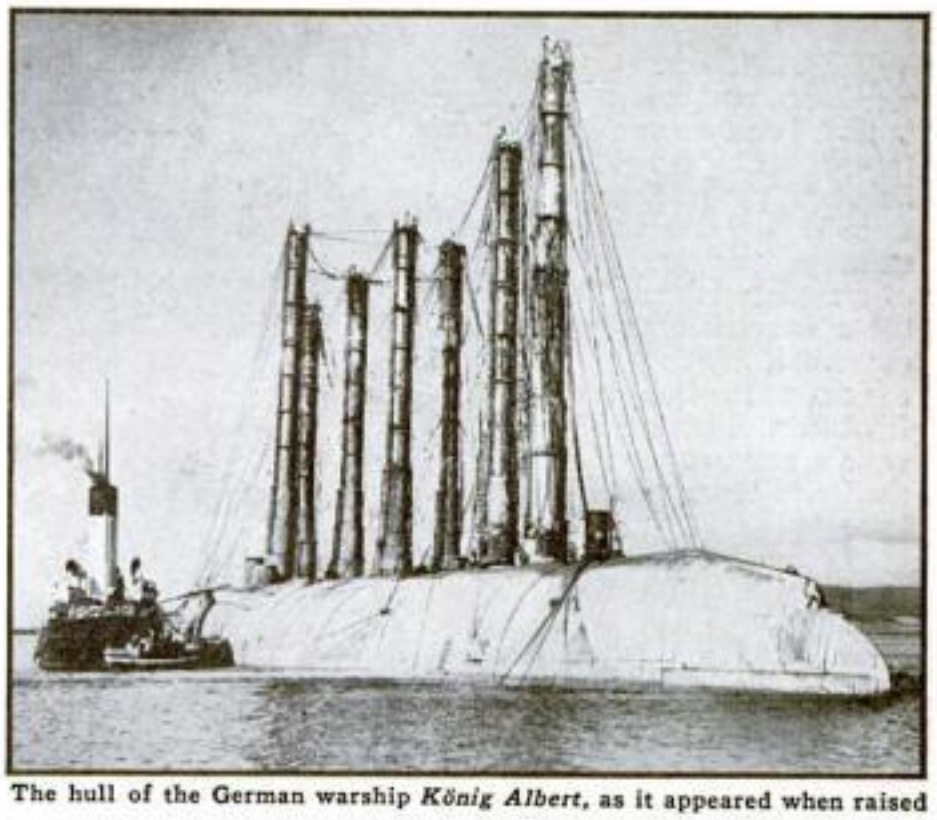
HOUSE FLIES *move their wings 330 times a minute; butterflies only nine.*

BREAD *3,000 years old was taken from a buried oven in Egypt.*

OSCAR, *the polar bear at the Rochester, N. Y., zoo, is the most photographed animal in America. New films are tested by photographing his creamy coat against a dark background.*

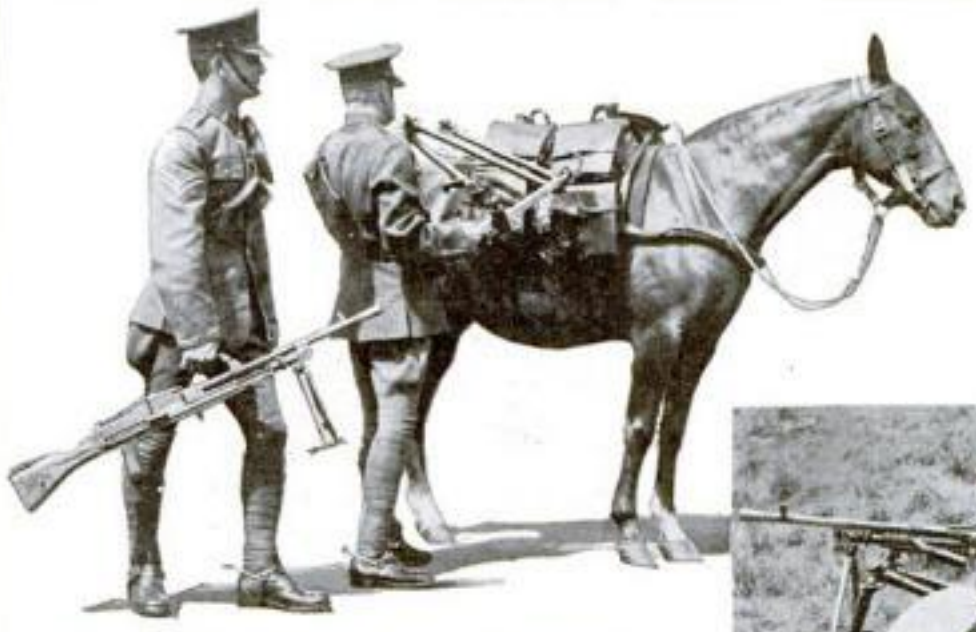
ODD AIR LOCKS HELP RAISE WARSHIP

WHEN Scottish salvagers recently succeded in raising the German warship *König Albert* from the bottom of Scapa Flow, where it had rested ever since it was scuttled by its own crew with other ships of the German Fleet in 1919, towering stacks atop the upside-down hull gave the vessel the curious appearance shown in the accompanying photograph. The 100-foot-high air locks were used by salvagers in entering and leaving the hull while it was being refloated.



The hull of the German warship *König Albert*, as it appeared when raised

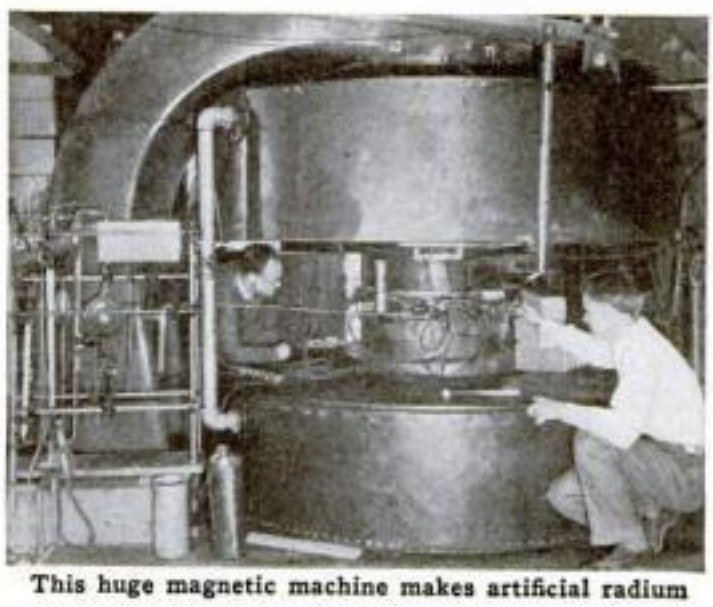
BRITISH GET LIGHT NEW MACHINE GUN



British cavalrymen loading one of the new machine guns on a pack horse. Note how easily it is carried. Below, the gun in action

BRITISH troops are being equipped with a deadly new arm — a lightweight machine gun of Czechoslovak design, shown in the accompanying illustrations. Chosen to supersede the American-type Lewis gun, which is six pounds heavier, the new weapon may be fired from the shoulder like a rifle or operated upon a two- or three-legged stand. It fires 600 shots a minute. Two interchangeable barrels are provided, so that, if one becomes overheated, the other may be substituted; the change requires only fifteen or twenty seconds. Twenty-four of the new guns will be issued to each infantry battalion.

ARTIFICIAL RADIUM MADE FROM SALT

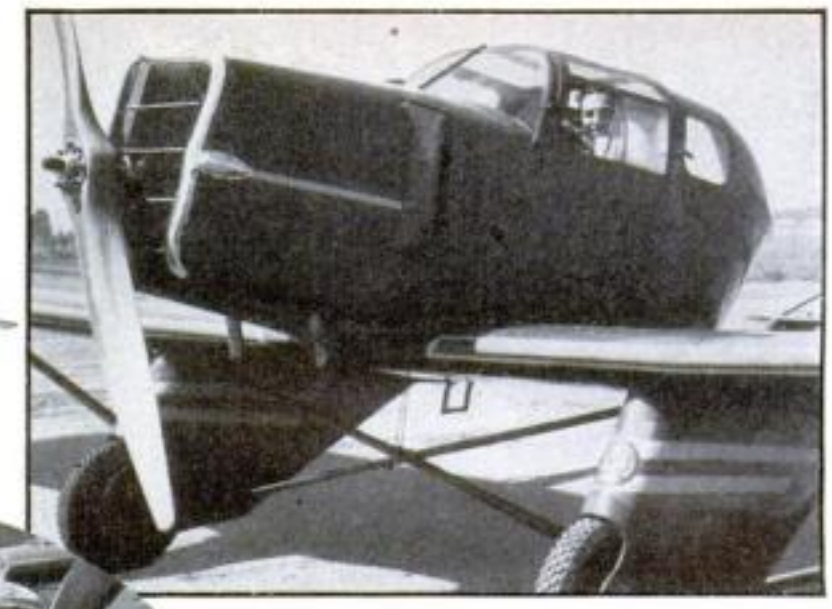


This huge magnetic machine makes artificial radium

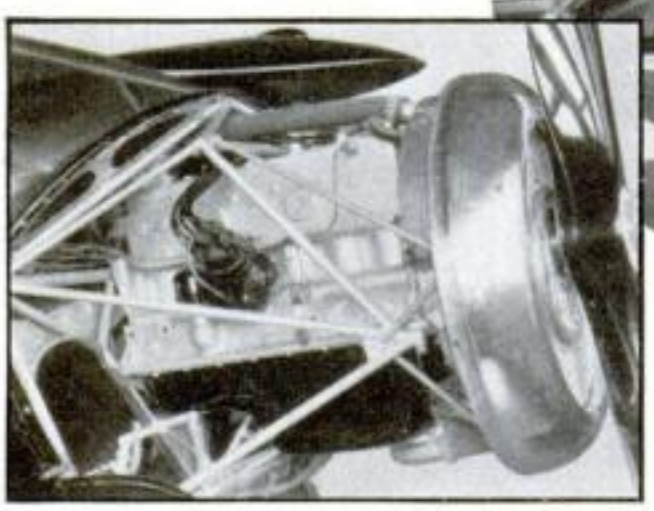
ARTIFICIAL radium may soon be available in quantities sufficient for medical use, as an inexpensive substitute for costly natural radium, according to its discoverer, Prof. E. O. Lawrence of the University of California. To obtain it, ordinary table salt is bombarded with electrified particles in a huge magnetic device known as a cyclotron. The "radio-sodium" thus produced emits rays even more powerful than those of radium, which costs about $2,000,000 an ounce, and its possible large-scale manufacture is foreseen as a boon to medicine for the treatment of diseases, and for experimental use.

NEWEST FLIVVER PLANES RESEMBLE AUTOS AND USE STOCK AUTOMOTIVE ENGINES

AIRPLANE designers are turning toward automobile lines, in their latest models introduced for private flying. Stripped of its wings, the fuselage of one of these new planes would bear a striking resemblance to the body of a modern motor car, even to the automobile-type radiator at the front, which the propeller cools after the fashion of a giant fan blade. Lifting the hood reveals a stock automobile motor, similar to those used in popular low-priced cars and capable of being repaired by any garage mechanic; special gearing adapts it for airplane use. Interior fittings, including instrument panels and roll-down windows, are also of automobile type. The new planes, according to the makers, take advantage of the economies resulting from mass production, to which automobile design lends itself.



Its automobile-type body, radiator, and engine make this plane a veritable flying motor car. Small view shows it in flight



Another small plane for private flying. At left, raising the hood reveals a stock auto engine that any garage mechanic can repair or overhaul

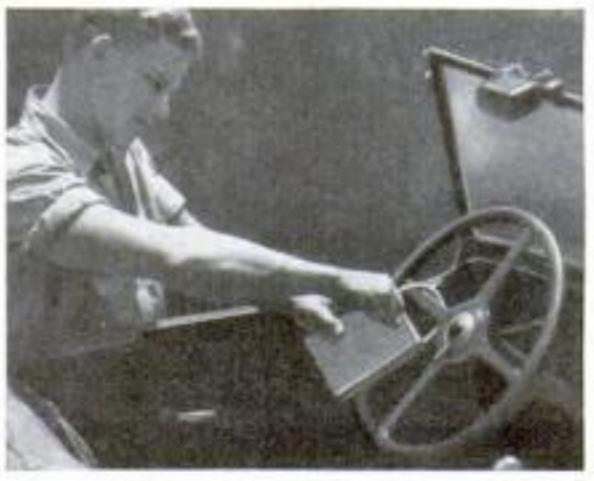
One model of the new "flying autos," a low-wing monoplane of thirty-four-foot wing span which recently made its initial test flight in Southern California, carries two persons at a cruising speed of 100 miles an hour. It uses ordinary automobile gasoline as fuel, flies about thirty-three miles on a gallon, and will be sold at a figure comparable to the cost of a medium-priced automobile. A slightly smaller craft, introduced by another maker, is a high-wing, two-place monoplane with "knee-action" landing gear. Wing flaps serve as air brakes and enable it to land in a space only 200 feet long.

GREENHOUSES ARE BUILT AROUND GIANT CACTI

BECAUSE the plants were too large to be placed beneath a glass roof, greenhouses were constructed around the bases of two giant cacti recently acquired by the Huntington Botanical Gardens at San Marino, Calif. The cacti are of a species native to Arizona, where they sometimes attain a height of sixty feet. It is the only giant cactus that thrives virtually without water for periods of two and three years. Protection was required from excessive moisture, which rots the bases of the plants.

HE PRODUCES FOGS FOR THE MOVIES

WHEN a movie scenario calls for a fog, it's a busy day for the technician operating the valves in the picture at the right. Employed by a Hollywood, Calif., studio, his odd specialty is the production of any required degree of fogginess, from a light haze to the "pea soup" variety for which London, England, is celebrated. Discarding the chemical mixtures previously used for artificial fogs, because they irritated the nose and throat, he devised a substitute by spraying mineral oil from a nozzle with compressed air under high pressure. By heating, he controls the height to which the fog will rise.

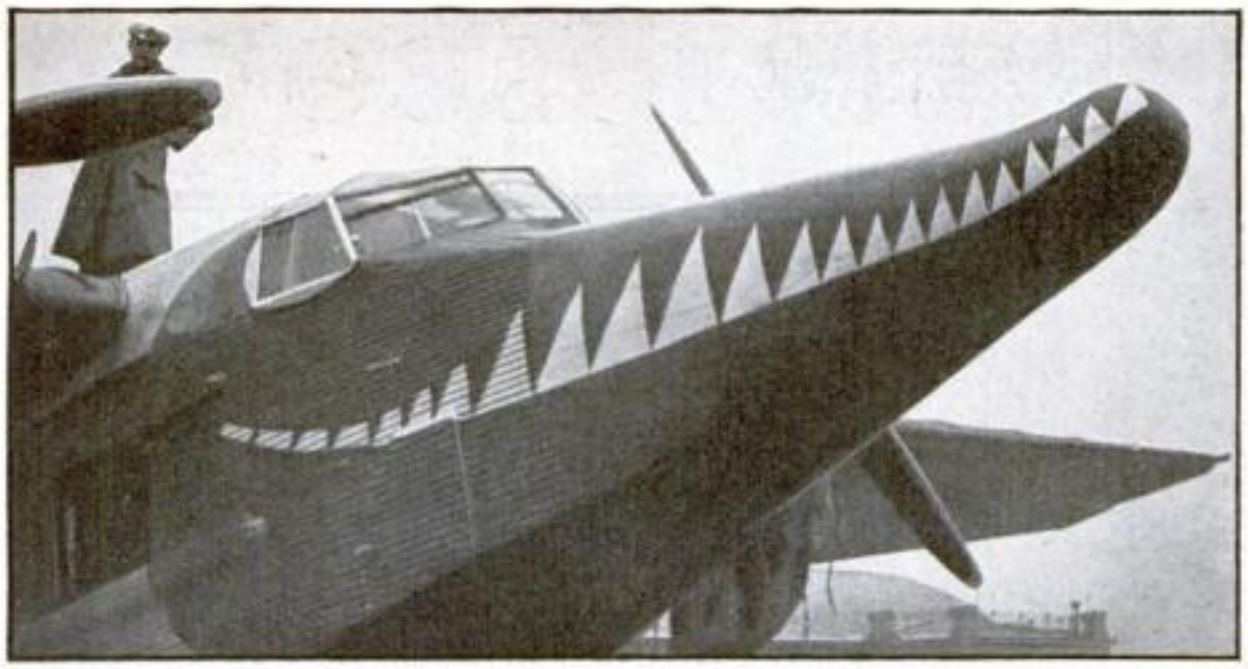


One operation locks safe to auto steering wheel

PORTABLE SAFE LOCKS TO STATIONARY OBJECTS

TO PROVIDE a secure place for a traveler's money, papers, and other valuable objects, a new portable safe has been introduced. Its locking ring may be attached in a jiffy to the steering post of a car, or to an immovable piece of furniture in a hotel room, making it impossible to carry away. Made of two sturdy telescopic steel sections, the safe is declared to be proof against tampering. A single locking operation fastens the two sections together and attaches the safe to the stationary object.

FANTASTIC PLANE HAS CROCODILE NOSE



A GROTESQUE nose with painted jaws and teeth gives a new Russian plane its nickname of the "flying crocodile." Designed for advertising purposes, the odd craft affords an arresting spectacle during flights from its base at a Moscow airport. The photograph above shows the striking appearance of the big twin-motored machine, which has a seating capacity of nine persons.

MERRY-GO-ROUND GIVES STRAIGHT RIDE

TOWED by a truck, a new "straightaway merry-go-round" designed by a California inventor gives children an exciting ride. When the vehicle is in motion, an eccentric attached to the rear axle of the trailer imparts a galloping motion to sixteen horses. An operator at the rear, by pulling a lever, can disengage the horses from the driving mechanism if anything goes wrong while in operation.

With this pocketbook you can dial for a cigarette

Open pocketbook shows magazine which ejects cigarettes through an opening in purse

WOMAN'S PURSE HAS CIGARETTE DISPENSER

SO THAT cigarettes will not become lost or crushed among the miscellaneous contents of a woman's pocketbook, a new purse is provided with a built-in magazine and a handy dispenser. When a knob on the side of the pocketbook is turned, a single cigarette is ejected from a small aperture, making it unnecessary to open the bag. The magazine holds fifteen cigarettes and these are kept in place and fed to the ejector by a flat, flexible spring. As one cigarette is ejected, the next drops into place and the user always receives a firm, unbroken cigarette.

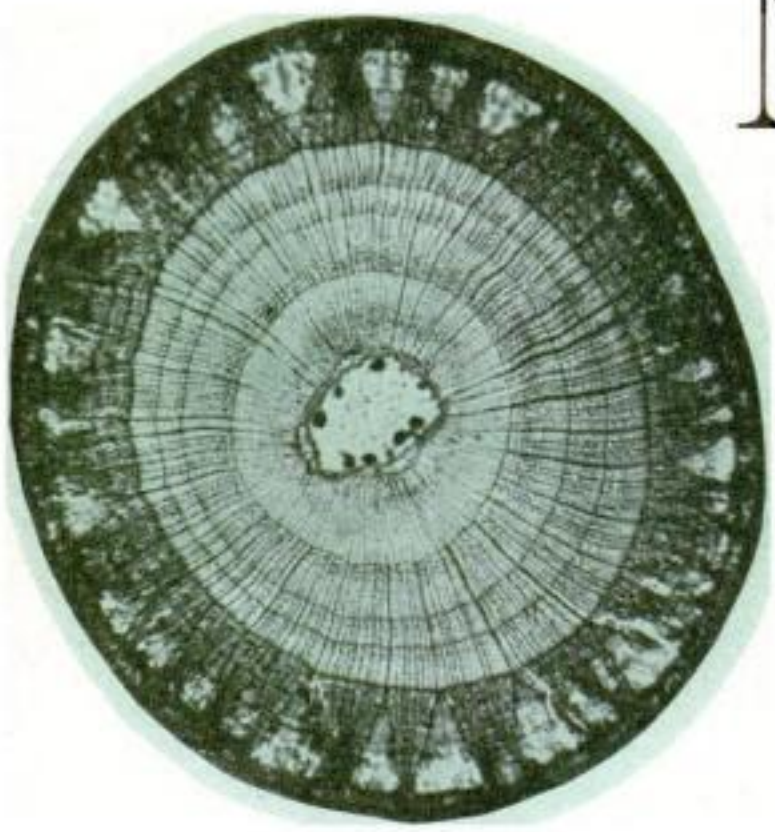
SCULPTURES HANDS FOR PERSONALITY STUDY

STUDIES of human hands are the unusual specialty of Helen Liedloff, New York sculptress, who maintains that they suffice to reflect the personality of the sitter. Among the celebrities she has pictured in this way are Albert Einstein, famous physicist, whose short, plump hands are shown resting upon a globe, and Sergei Rachmaninoff, renowned composer, whose lean, agile fingers are depicted on the keyboard of a piano.

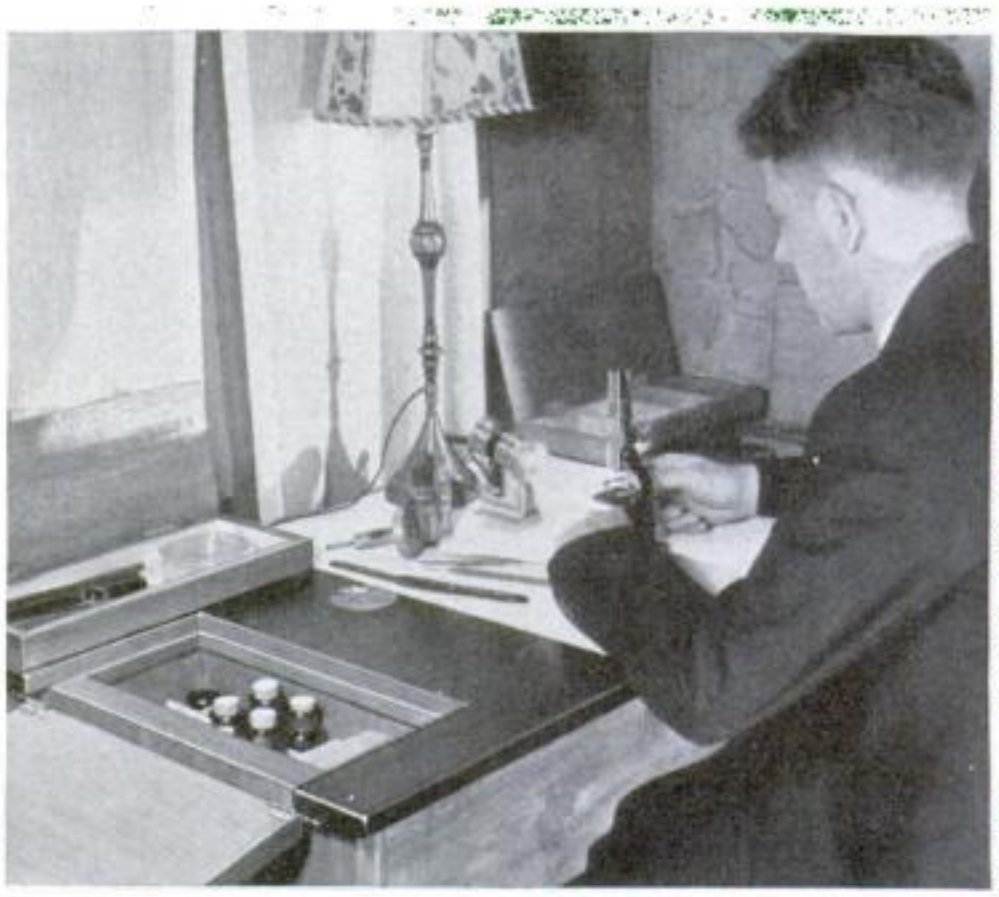
Models of hands which show distinct personalities. Einstein's hands are short and plump, while Rachmaninoff's (right) are lean and agile

Helen Liedloff, sculptress of hands, at work in her studio

Microscopic



A stained section of a basswood stem, magnified fifteen times. The pith center is surrounded by rings of woody cells and beyond these are the vascular bundles



This work table for the microscopist, described on the opposite page, has sunken compartments for bottles and other paraphernalia. At left, slicing a tulip stem with a razor on a cork pad

Stems of Common Plants Afford An Almost Unlimited Field for Amateur Study and Observation

By MORTON C. WALLING

POSSIBLY you are all set for a microscope journey but have no place to go. At least, so you think. But if you have a botany textbook, it will offer suggestions for many interesting trips.

Even if you concentrate on only one small but important part of the plant structure, you will find no end of material. Suppose, for instance, that you decide to investigate stems—to look at all kinds of stems, and to slice up in various ways and examine every stem you can get your hands on.

Sounds simple, doesn't it? The work of an hour or two, you think. But in truth it would take you weeks, months, even years to learn all there is to be known about stems. A piece of lumber is nothing but part of the stem of a tree. And there are scientists who do nothing but study wood!

A stem's main job in life is to support the leaves. It also carries water and food, and assists in other minor ways. Botanists classify stems as herbaceous and woody. The first kind is much like a leaf in construction. If you slice a herbaceous stem, such as that of a clover plant, crosswise into very thin sections and examine one of them with your microscope, you will see that the stem has a distinct structure.

There is, encircling it, a thin layer called the epidermis. This is composed of transparent cells. Directly below it is the pale green chlorenchyma which, by its color, suggests that it helps out the leaves in the manufacture of food for the plant. Next, in order, are the veins, known by a variety of aliases such as fibrovascular bundles, vascular bundles, or just plain bundles. Usually these veins are grouped into a ring, encircling the center section of the stem. Under the microscope the veins, water pipes of the plants, are usually very distinct. Their job is to carry water through the stem. In the center, enclosed by the ring of veins, is the pith, a sort of food-storage reservoir for the plant.

In older parts of stems, there can be seen further refinements in the stem structure. Extending through the bundles of cells making up the veins, and uniting them into a sheath, or ring as it appears under the microscope, is the cambium layer, the seat of growth in the stem. It is this layer that, by cell multiplication, grows and produces new material both inside and out.

Then there is, directly beneath the almost transparent epidermis, a white band of tissue that glistens when the illumination is right. This is the collenchyma, a reënforcing sheath whose function is much the same as that of the wire or iron-rod reëforcements in a concrete pole. Engineers have copied this collenchyma in the building of airplane frames with steel tubing that is light in weight yet strongly resistant to lateral strains.

Tear almost any soft stem into shreds and examine the particles under the microscope. Among the masses of tissue you will see long tubes resembling tightly coiled springs. These are the ducts or tracheids which help make up the fibrovascular bundles. Other large tubes resembling cylindrical sieves may be seen. These tubelike cells run to all parts of the plant, from root tip to branch tip, carrying water and food. The balsam and some other plants produce stems transparent enough for you to see the water-carrying cells without making sections or tearing the stems apart.

Stems of the clover, geranium, soft tips of tree branches, and almost all other herbaceous stems show, in cross section, a ring-shaped arrangement of the veins. However, the corn plant is different. Cut thin slices from a young corn stalk and examine them. You will find that, at fifteen or so diameters, the specimen reminds you of a lace doily. Among the thin, almost colorless pith cells are arranged, in a more or less evenly spaced fashion, the fibrovascular bundles.

Woody stems are grown-up herbaceous stems. By studying such stems with your microscope, you can learn why leaves fall in the autumn. If you slice a twig lengthwise at a point where a leaf is growing,

Marvels YOU CAN FIND IN YOUR GARDEN

you can see that the veins branch out from the twig and follow the leaf stem.

In the late summer or fall, a layer of tissue grows across the base of the leaf, gradually closing off the water and food supply. The leaf, deprived of water and food, begins to wither. The chlorophyll quits work and the leaf changes color. Finally it falls, dead, to the ground. The abscis layer of tissue that grew across the base of the leaf becomes a corklike seal for the scar left on the twig stem.

Examine a winter twig at low magnification and you will see that it is covered with tiny wartlike projections. These are the lenticels. When the leaf dies and drops off, its stomata, or breathing pores, naturally can no longer serve. But the tree must continue breathing through the winter. So, over the surface of the winter twig, the usual epidermis is replaced by a waterproof layer of corklike material, which is pierced with many lenticels. These lenticels serve as breathing pores in place of the stomata of the leaves. Respiration is vital to the living tissues inside the twig.

If you cut a cross section from one of these transitional stems or winter twigs, you will see that *(Continued on page 101)*

The beauty of plant stems under the microscope is greatly increased by the application of a stain, as illustrated above

Build This Handy Microscope Work Table

AT A recent hobby show held in New York, a young man watched—fascinated—while an amateur microscopist showed how a fly's eye could be removed and mounted on a slide in something less than two minutes.

"You know," the young man said, leaning forward eagerly, "I've read a lot about microscopes but I never got one because I haven't any place to work."

"You can borrow the kitchen table for part of the evening, can't you?" the amateur microscopist asked.

"Sure. But you've got to have a whole room to ride that hobby."

"That's where you're wrong," the amateur smiled. "One of the best things about microscopy as a hobby is that it is convenient. You can practice it almost any place—in the kitchen, parlor, bedroom, or basement."

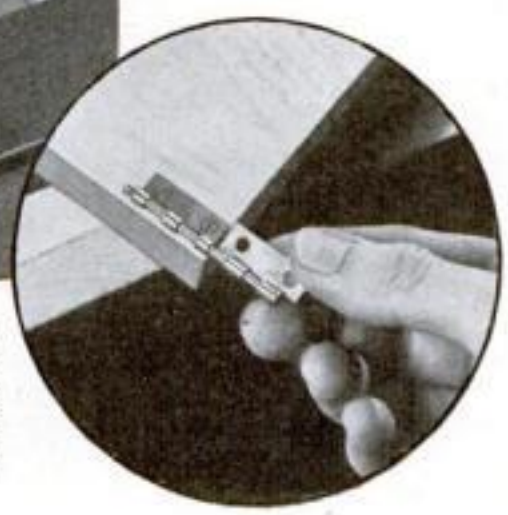
The amateur was right. You can discover much of the invisible world that only the microscope owner knows, if you can find a two-foot-square space on which to work. However, it cannot be denied that a permanent place to pursue your hobby, such as a table or perhaps even a small room set aside for a microscope laboratory, is a highly desirable convenience.

Almost anyone can find space for a modest-sized table that will house the accouterments of his hobby. The making of a table like that shown in the picture at the top of the opposite page, is not difficult. It does not require elaborate machinery. Cost is a matter of two or three dollars for materials.

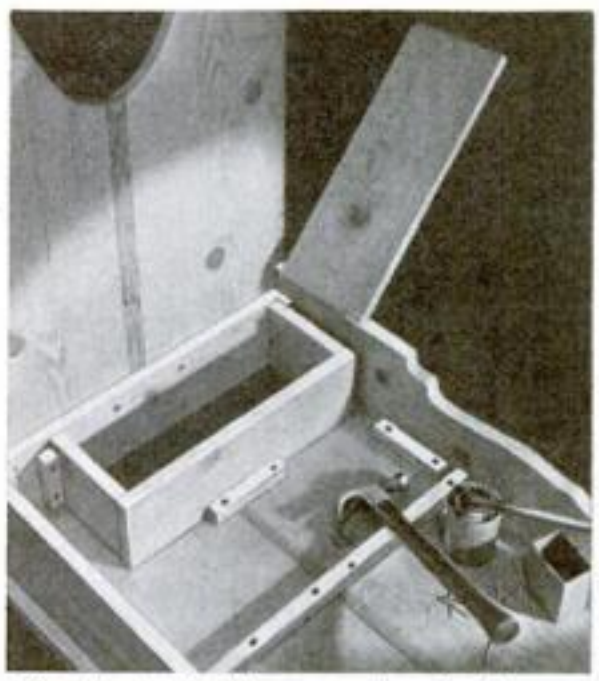
Almost any wood can be used; redwood, pine, and cypress being among the cheapest and easiest to work. Use one-inch stock, sanded on one or both sides. The table, whose construction and dimensions can be determined from the diagrams, is similar to any ordinary table except that it has a comfortable footrest and two wells, one at each end, covered by hinged lids, for the storage of reagent bottles, specimens, and equipment.

The lids are hinged to swing upward and outward when they are grasped at their outer edges with a turning motion. The table shown was made of knotty white pine, and stained to harmonize with other furniture. Its top was painted with a chemical-resistant paint, although ordinary floor or deck paint will be a sufficient covering.

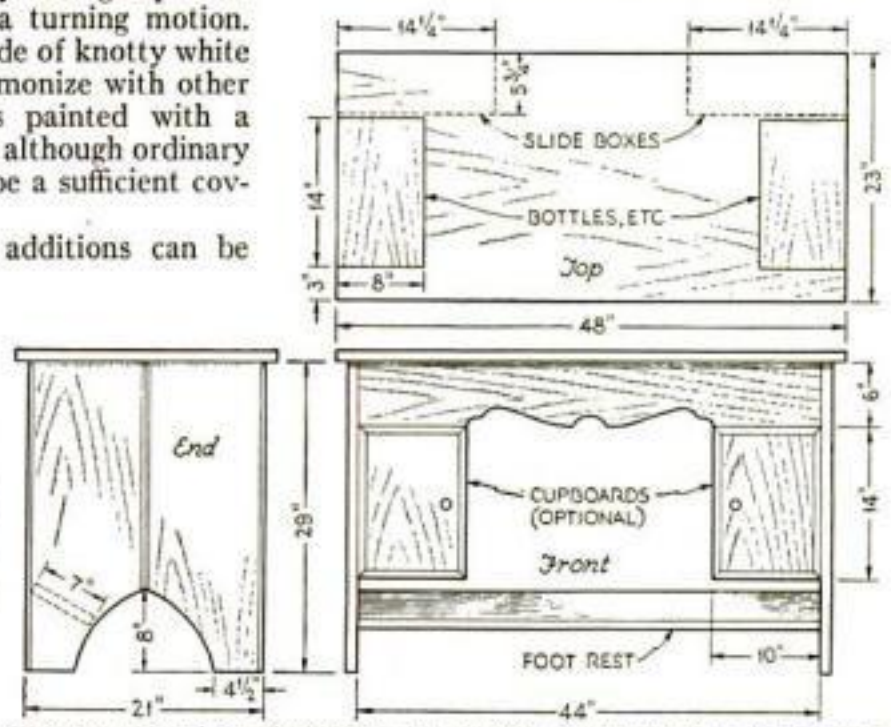
From time to time, additions can be made to the table in the form of boxes mounted on the top or directly behind the hinged lids for holding slides and the like. Cupboards or drawers may be installed inside the end pieces as needed.



Sunken compartment of the microscope work table, with the lid turned back on its pivot hinges. The bottle rack is made of light wood. The picture at right shows how a butt hinge is rearranged into a pivot



Details of underside construction, showing one of the sunken compartments for storing bottles



This drawing gives dimensions and details of construction of the work table described above. Cupboards and drawers can be added if desired

AN EXPERT TELLS YOU

How to Prune Your Shrubs FOR BEAUTY

Hydrangea stems bear flowers in alternative years. The stems indicated with the hands, above, will bear next

Rose blossoms should be picked when the buds begin to unfurl. Cut each stem within three buds of its base, as illustrated in the drawing

By R. SANFORD MARTIN

EVERY shrub, from the smallest flowering plant to the tallest tree, has a definite height at which it attains maximum attractiveness. Since this cannot be changed by artificial treatment, natural growth should be encouraged at all times. This may be accomplished more perfectly by proper pruning than through any trick methods.

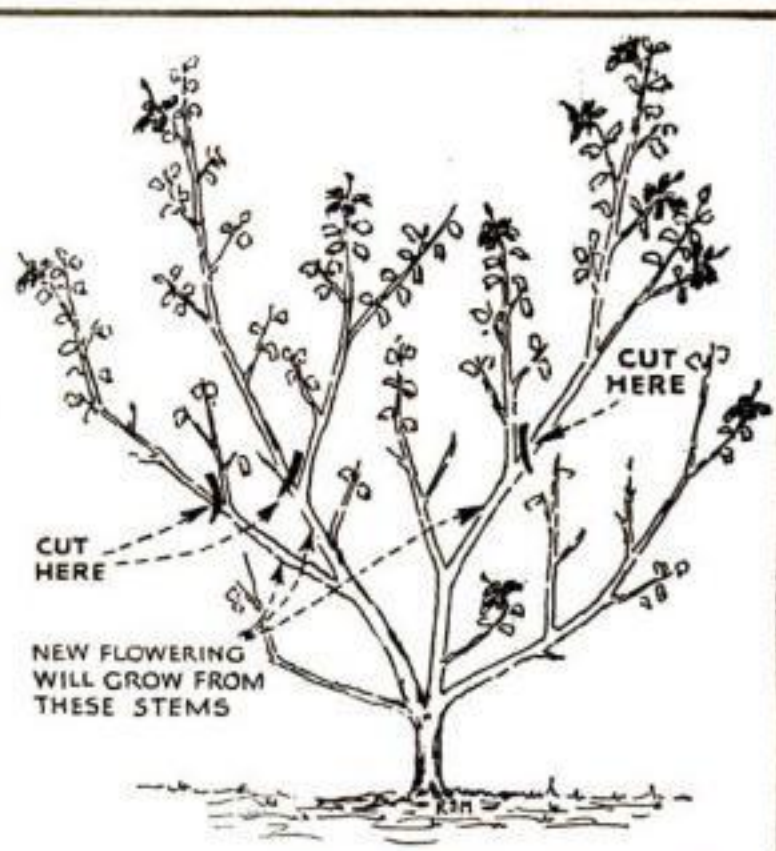
Plants drop their flowers, fruit, or foliage at different times in the year. It is not possible to prescribe, in limited space, specific pruning periods for the many species. One general rule, however, applies to all plants: trim them as soon as they have produced that for which they were grown, whether flowers or fruit.

The various ornamental trees and shrubs react differently to pruning. One requires severe trimming and grows even more rapidly than before; another must be pruned by successive stages for best results. In the paragraphs that follow, I have attempted to explain methods of pruning typical plants of several families, selecting those most widely planted through the United States.

Fast-growing plants and shrubs of unusual physical proportions, and those grown for the beauty of their flowers and fruit, require more attention than shrubs grown merely for foliage effects. Conditions along the Pacific Coast and in the southwestern and southern states give all plants a much better opportunity to come into flower or fruit earlier than in climates of cold winters.

You can easily determine how long a plant requires to produce the twigs bearing either blooms or fruit, and whether this same wood will support a crop the following season. If the plant in which you are interested produces flowers on one-season wood, as do hydrangeas, roses, and bridal wreath, this wood must be removed to make way for new branches to be developed in future seasons.

On the other hand, shrubs such as flowering almond and viburnum which produce blooms year after year on the same spurs require only enough pruning to keep the main bodies open to the sunlight, either direct or indirect. In pruning for the necessary open effect, particularly on plants growing on the north side of the house, remove older branches and any interfering stems from the plant to produce even distribution of



As a hibiscus plant grows, its branches spread out from the center. The diagram shows how pruning can preserve symmetry. Hibiscus should not be cut heavily at one time

branches and permit moderate penetration of light.

By removing branches as soon as they have fulfilled their purpose, you can keep new crops of branches coming on through the year. These will grow to natural proportions and set maximum numbers of flowers. Growth of this type is more attractive than hedging, and in the long run requires less attention. On flowering shrubs, hedging destroys most of the plants' flowering abilities; too, trimming only on the outside shuts out the light so essential to their good health.

Only a few simple tools are required for even the most meticulous pruning. Most valuable is a good pair of hand shears with a blade so designed that it will make good, clean cuts without crushing stems. A curved-blade pruning saw, long-handled shears, hedge shears, and pruning knife complete the outfit.

WHEN a cut is to be made, whether on shrub or tree, cut as closely above an old leaf scar or bud as possible. A cut of this kind will heal over more rapidly, with less likelihood of die-back or internal rot, than where a cut is made anywhere between leaf scars or buds. This is particularly important where plants are subjected to rains throughout the summer, for continued moisture breeds disease.

Plants of the same family may require different pruning treatment, depending upon their use as tree or shrub. Oleander, for instance, appears both as a tree and as a shrub, with exactly opposite systems of pruning recommended. Young tree plants should be staked for the first three or four years. Pinch off any buds or shoots that form anywhere along the stem except at the end. Continue this pinching process until the tip has reached a six-foot height, then the top will take care of itself. When suckers appear at the base, dig down below the surface and pull them off where they join the root stock.

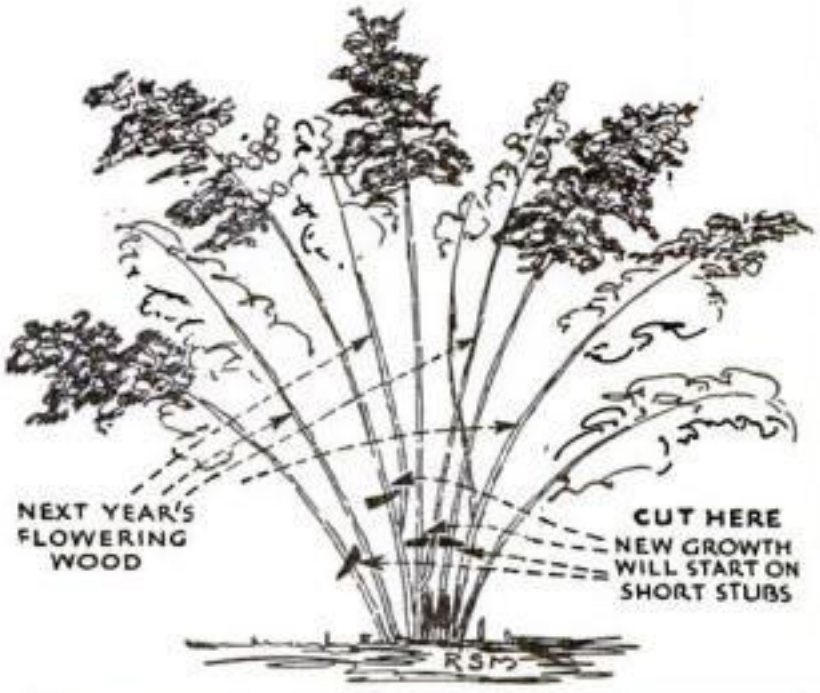
Where this plant is to be used as a shrub, the sucker growth should be encouraged, keeping the plant at an even height and constantly replenishing the flowering wood. As soon as a bloom cluster has finished flowering, remove the entire stem by cutting it out almost to the ground, which will cause a new growth to replace it. Pruning should not be started on oleanders until they are at least four years old.

In pruning shade trees, hold the shears with blade cutting downward; press down on the branch, to make cutting easy

Differences in pruning deciduous and evergreen varieties may be easily noted in spirea, or bridal wreath. Deciduous spireas may be treated alike, since all produce their blooms in the same way. Pruning may begin after the third year, and should take place as soon as the flowers have dropped in the spring.

Since the better flowers are produced on young wood, keep older wood cut out and new flowering branches coming on. You will note, when the shrub is in full bloom, that the older stems bear fewer flowers. These branches should be cut well down to the base, as soon as the petals have dropped, leaving a stub of about six inches. New shoots will form on these stubs, and will flower in the following spring. Some of the spireas spread widely, and in such cases the spreading branches should be trimmed close to the ground to encourage center growth.

The evergreen spirea requires an entirely different type of pruning, which should be carried on through the summer months while the plant is in bloom. The best flower clusters are borne at the ends of the branches. The secondary bloom, or that which grows out from side buds after the main flower has been fully developed, will not be as large a cluster, nor will it show up much on the plant, because it is down in the body of the shrub. This secondary bloom should not be considered. As soon as the main flower has dried, cut off the entire stem upon which it was borne, leaving a stub of about three inches. New shoots will appear upon these stubs, and in time will make flowering stems.



The evergreen spirea should be pruned as it blooms. As soon as a bloom dries, cut off the entire stem that bore it, leaving only a short stub

When oleander is cultivated as a shrub, sucker growth should be encouraged, keeping the plant at an even height and replenishing the flowering wood

ROSES are, by nature, deciduous plants, and should have a definite period of rest once a year. However, in mild climates they will grow as evergreen plants if allowed to do so. In fact, in the milder climates of the South and West they are very likely to wear themselves out with overblooming and by remaining continuously in a growing condition.

Roses should have a heavy pruning every two winters, and a light cutting back in alternate years. This treatment will keep the plants in a good, healthy growing condition, which will develop plenty of flower-producing wood if they receive the proper amount of fertilizer.

In heavy pruning, which should be done in early December, remove about two-thirds of the plant's growth, cutting out the heaviest wood first in such a way as to leave the bush evenly balanced with fairly young branches. All new growth should be taken back to within three buds or leaf scars of its base.

When the spring growth starts, there will be danger of suckers springing up from the root stock. This is particularly true of budded or grafted roses. Remove these suckers by digging down below ground level and cutting them off smooth where they are attached to the root. All of the best roses are either budded or grafted onto a hardy, disease-resistant root stock, and suckers from this stock will sap the top of all vitality if allowed to grow.

In light pruning, you need only thin out the interfering branches and cut all of the newest growth back to three buds or leaf

Side branches of cypress trees, falling away from the main column, may be cut off as shown

scars from the base of each branch.

Attention should be given to the picking of rose blossoms, as part of the general pruning. Pick the flowers when the buds begin to unfurl, cutting each stem within three buds of its base, regardless of the length. There will always be one bud at the extreme base of a stem, so count two buds or leaf scars above this one and sever the flower stem immediately above this last bud.

Roses should never be allowed to go to seed, as this reduces the flowering ability of the plant. In removing the seeds, follow the same method as in picking a flower in order to make way for additional flower wood. Good-quality roses will not be produced from the buds farther out on the stems.

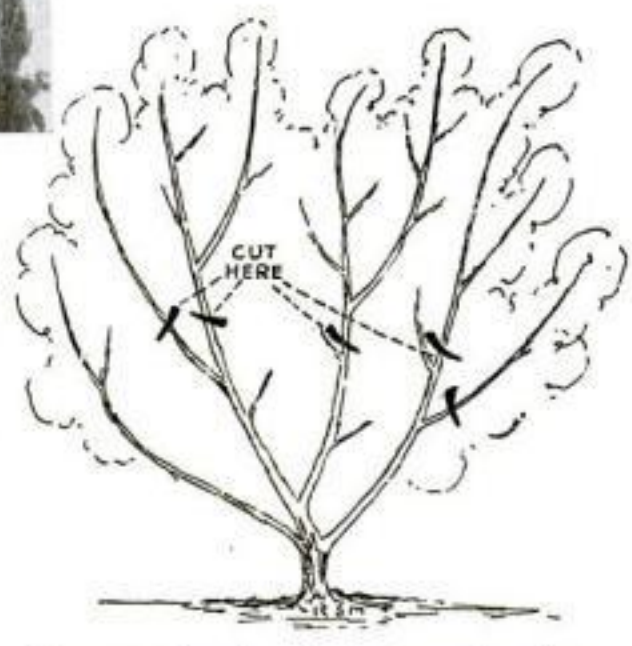
THE beautiful hydrangea is universally grown, yet few understand the care needed to produce the largest flowers. When the plant is in full bloom, only about half of the stems carry flower heads. This is a natural condition, and this year's nonproductive stems will bloom next year. When the flowers have dried up or fallen, all stems on which the flower heads were borne should be removed. In removing these stems, cut them out almost entirely, leaving only two buds or leaf scars at the base of the stems from which future flowering wood will come. Hydrangeas should be pruned annually after the fourth year.

The hibiscus should not be cut heavily at any one time. When the plant gets too large for its location, the larger branches have a tendency to grow out from the general center of the plant, at all angles. In selecting wood to be cut out, pick the limbs from several parts of the plant, so that too big a hole is not left in any one place. Do not remove more than a third of the largest branches at any one time. It will be better to allow three or four months to elapse between heavy cuttings.

The hibiscus produces the best flowers when the plant is growing rapidly, and cutting out of the coarse wood will promote growth. Where all the wood is left on these plants, year after year, the flowers will gradually lessen in size until they are about half the normal proportions.

The Cotoneaster type of berry shrub includes a popular and beautiful group. If you will follow a consistent system of cutting, your plants of this family can be kept practically the same size year after year, and loaded with berries every season. Remember that berries are borne on one-year-old wood only, and once that wood has produced a crop, it is through fruiting. New wood must be produced each year for a proper setting of berries.

Pruning may start on the Cotoneasters any time after the plants are three years old, and should be done on all varieties as soon as most of



Frequent trimming of privet promotes dense foliage. The drawing above shows how to cut

the berries have fallen. In cutting sprays of berries for Christmas decoration, keep the pruning of the plant in mind. When pruning these two-year-old branches, cut them six or eight inches from their base. This will cause the new growth to push out on the old stub, within the first three or four inches below the cut. This family of plants is particularly subject to throwing out new growth immediately below any major cut; consequently, they become top-heavy very quickly when they are cut high, or hedged.

Smaller varieties of Cotoneaster require little pruning. Since they are mostly of dwarf and trailing habits of growth, about the only thing that can be done with them is to keep them sufficiently thinned out by cutting well into the body of the plants to encourage graceful growth.

Hedges and trees are definitely shrubs in the ornamental sense. In starting a new hedge, it is advisable to allow the new plants to attain the height desired of the hedge before stopping the terminal or end development. Once this height is attained, never allow any growth to go above it. As the plants grow from this point on, they will fill in the body of the hedge. Frequent trimming promotes dense foliage.

Hedge trimming is, possibly, the simplest form of pruning; however, since the human eye is not always infallible, tightly stretched strings will help you to achieve straight lines. You will find it easier to trim off the top of the hedge first. Stretch a line at the desired level from one end of the hedge to the other a little to the side, and trim with the shears down to the level of this line.

Next, by setting stakes at either end of the hedge, in line with the desired edge, and stretching lines along the top and bottom, trim out all growth that is out of alignment between the two strings. The result will be a neat hedge the first time over.

Some hedges require heavy trimming every year, in early spring, immediately before new buds begin to develop for the summer's growth. If a clean and accurate job is done, the lighter trimming may be undertaken during the summer, whenever necessary, without the aid of guiding lines.

The type of shrub selected for the hedge is largely a matter of personal choice. Within the privet group are several hardy, fast growers that are usually planted when a screen is desired quickly.

The desired height may be maintained indefinitely by keeping the plants thinned out, or removing some of the largest, coarsest branches every year. In thinning, select the largest branches, or those growing most out of bounds. Take them out entirely, well down into the body of the plant. As the privets are grown mainly as a foliage plant, they may be pruned at any time of the year, but the heaviest cutting should be done during the winter while the plant is dormant.

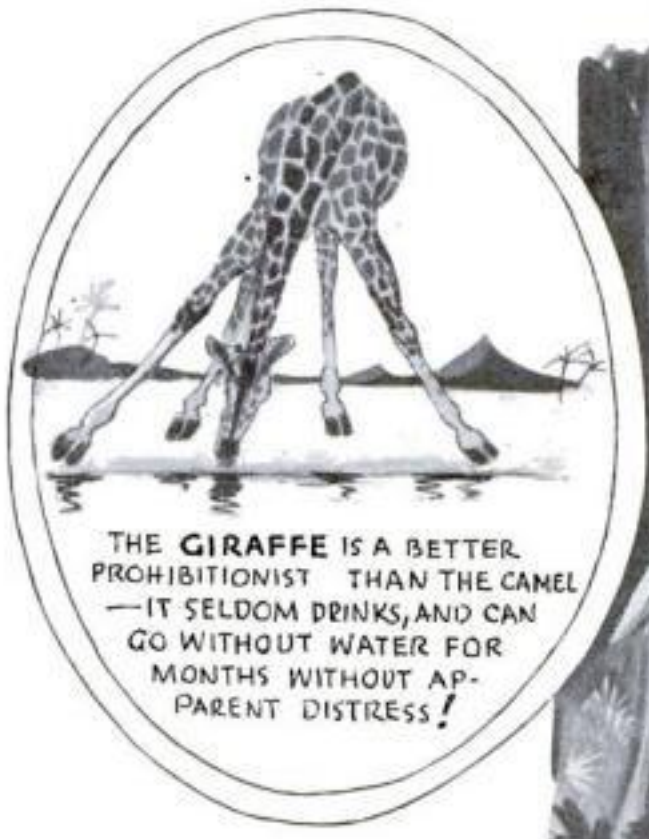
Trees are as much a part of your scheme of shrubbery as hedges. Shade trees should be given close attention during the first three or four years of their growth. Training for a straight trunk, the first requirement for a shade tree, may be accomplished by *(Continued on page 115)*

Bearing branches of Cotoneaster, like the upper one in the photograph, should be cut away after bearing to increase the plant's vitality. The lower branch is of this year's growth, and will have berries next season

Un-Natural History

By GUS MAGER

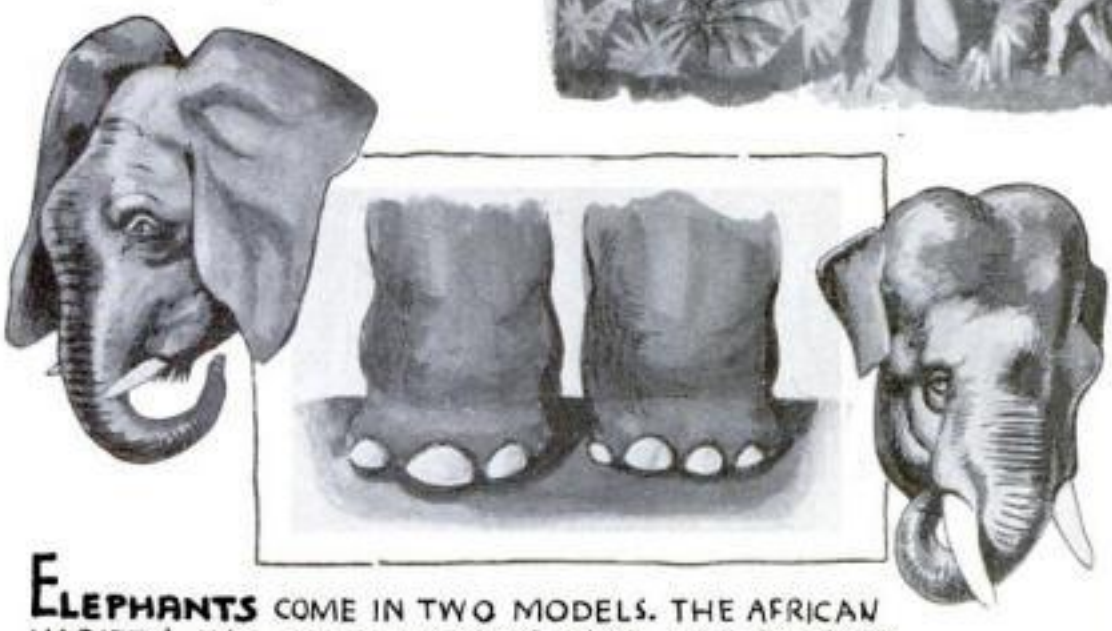
THIS FREAK, THE GIANT **ANTEATER** *(CENTRAL AND SOUTH AMERICA)* SEEMS A TOSS-UP BETWEEN BIRD, BEAR, AND SKUNK! ITS RIDICULOUSLY ELONGATED HEAD RESEMBLES A BIRD'S! IT HAS THE SKUNK'S COARSE MOP OF A TAIL, WHICH SERVES AS A SUNSHADE BY DAY AND AS A BLANKET BY NIGHT, AND THE POWERFUL LIMBS AND CLAWS OF A BEAR. ITS MOUTH IS A MERE KEYHOLE FOR THE EXTRUSION OF ITS STICKY, WHIPLIKE TONGUE, WITH WHICH IT LICKS UP THE ANTS ON WHICH IT FEEDS!



THE **GIRAFFE** IS A BETTER PROHIBITIONIST THAN THE CAMEL —IT SELDOM DRINKS, AND CAN GO WITHOUT WATER FOR MONTHS WITHOUT APPARENT DISTRESS!

THE WINGS OF THE NEW ZEALAND **KIWI** ARE SO RUDIMENTARY THAT THERE IS NO OUTWARD SIGN OF THEM — THEY'RE AS USELESS AS FLAT FEET TO A FISH!

IN BRITISH GUIANA, NATURALISTS HUNT THESE HUGE BUPRESTID BEETLES WITH TWELVE-GAUGE SHOTGUNS! THE HUGE BUGS — AS LARGE AS SMALL SAUCERS — ZOOM UP THROUGH THE JUNGLE TREE-ROOFS LIKE WILD FOWL!



ELEPHANTS COME IN TWO MODELS. THE AFRICAN VARIETY HAS HUGE, FLAPPING EARS LIKE BEGONIA LEAVES, AND THREE TOENAILS ON ITS HIND FEET. ASIATIC ELEPHANTS ARE EQUIPPED WITH SMALLER EARS AND GENERALLY HAVE FOUR TOENAILS ON THEIR HIND FEET.

OF COURSE, the title of this page is a contradiction in terms. There can be nothing "unnatural" in nature. Yet, so out-of-the-ordinary and astounding are some of the variations and experiments of Old Mother Nature, that the words seem justified. Nature loves a paradox, and is fond of making birds that act like animals, animals that resemble birds, and fish that appear like anything except a fish.

Household

LIGHTEN THE TASKS

LAMP SHADE TURNS UP OR DOWN. This new-type floor lamp has a shade which can be tilted up toward the ceiling for indirect illumination or down for close work. A mercury-capsule switch automatically turns on a 150-watt bulb when the shade is turned up; an ordinary switch controls the smaller bulb for close work

KEEPS FOOD AND BEVERAGES WARM

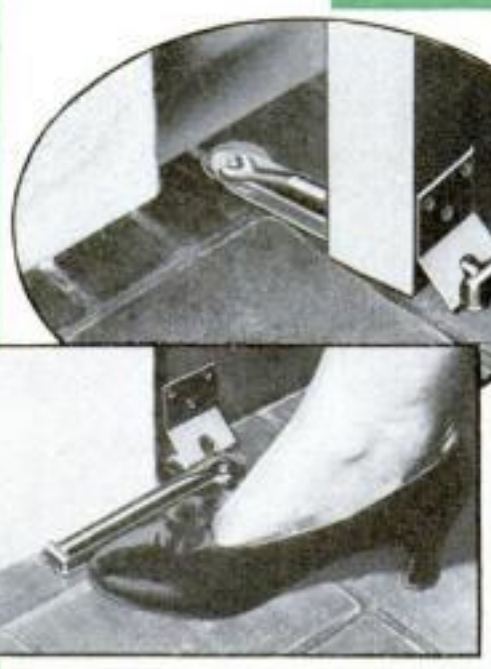
A wax candle, burning inside the glass bowl, supplies the heat for the beverage warmer illustrated below. A glass cup holds the candle and catches the drippings. Air holes in the bottom of the bowl, and vents in the chromium-finished lid, provide a draft. The unit is designed for use on the dining table

SPOON AND FORK COMBINED

The new piece of cutlery illustrated at the left is a cross between a spoon and a fork. It is recommended for eating gravies, stews, peas, desserts, and many other foods. It can be used with a knife, like any fork

KINDLING COMES IN CONCENTRATED FORM

A stick of the concentrated kindling shown at the left will burn with an intense heat for ten or fifteen minutes, without fumes, and is sufficient to kindle any fire of coal, wood, or briquettes. The sticks are neither explosive nor poisonous



NEW DOOR SAFETY LOCK IS INCONSPICUOUS

Installed at the bottom of the door, this safety lock is out of the way when not in use. As shown above, a metal arm pivoted on the floor engages a catch attached to the lower edge of the door. A flick of the toe swings the metal arm to one side when its protection is not desired

CLOTHESPINS OF METAL

So light that five dozen of them weigh only seventeen ounces, these metal clothespins can be carried conveniently on a hanger as shown above. They are made of tempered spring steel and resist stain and corrosion

Inventions

OF THE HOMEMAKER

HANDY IRONING TABLE

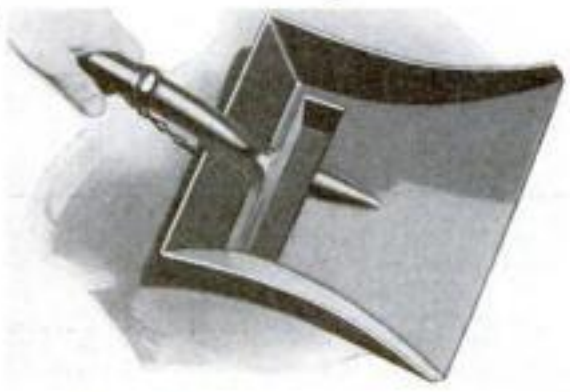
A single motion with one hand is all that is needed to open the ironing table pictured above. When set up, it stands on three rubber-tipped legs with ample space between for stowing a large clothes basket. It folds very compactly

FLEXIBLE MOLDING FOR OUTLET WIRES

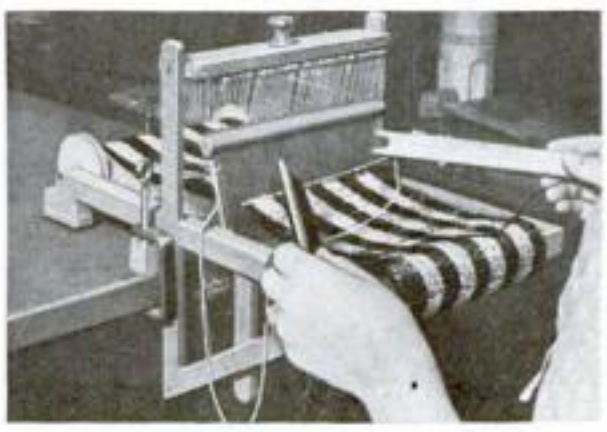
Additional electric outlets can be provided anywhere by the use of a decorative rubber molding which carries the wires. It is easily installed, being cemented to the walls without marring woodwork or breaking plaster

ELECTRIC TEAKETTLE. A ring-shaped, immersion-type heating element in the kettle at the left heats two pints of water to boiling in less than six minutes. It is filled through the spout, which is opened by pressing a trigger in the handle. The kettle whistles when the water boils

RESTORES CHIPPED ENAMEL. Chipped surfaces of enamel and porcelain can be repaired with a new cement which resembles sealing wax. The surface is cleaned and warmed, and the cement applied with a warm knife to form a glaze



DUSTPAN HAS STORAGE CHAMBER. This dustpan contains a little chamber in which dust can be stored as it is collected. It is emptied by pulling the chain seen in the picture above



NICKEL-IRON SKILLET

A new stain-resistant cast iron containing nickel is introduced to the household in the form of a shiny skillet which is said to combine good appearance with best cooking qualities

A LOOM FOR THE HOME

Interesting and beautiful fabrics can be produced in the home with the simplified loom shown at the left. It clamps to any table. A single needle handles two different colors

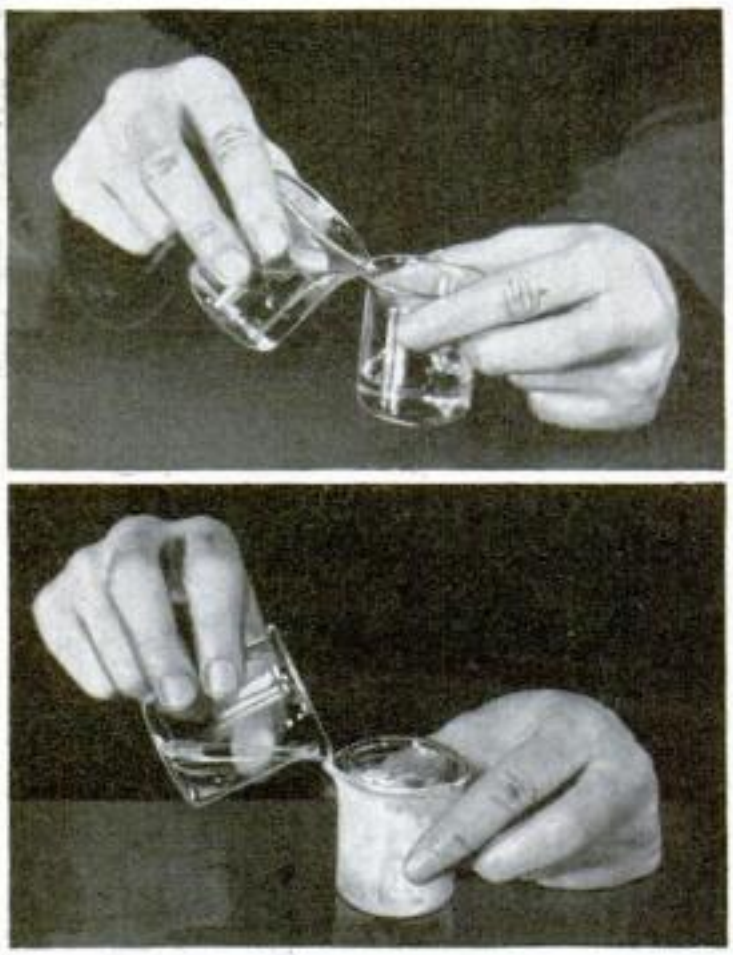
ICE-CUBE FREEZER

For making ice cubes in homes not furnished with electric refrigerators, this simple freezer has been developed. A hand pump supplies the pressure, and cubes form in the flask-shaped container

HOME STUNTS WITH

The Chemical Triplets

Calcium, Barium, and Strontium



THE HISTORIC MIRACLE OF CALCIUM

Two clear liquids, at top, are about to be mixed. The result, seen in the lower picture, is a mass of crystals which cannot be poured from the beaker

With Compounds of These Elements, the Amateur Can Make Unusual Preparations And Demonstrate Fascinating Phenomena

By RAYMOND B. WAILES

DID you know that you could add to the stock of chemicals on your shelf with the aid of rat poison? Or that, by surprisingly similar reactions, you could prepare a luminous paint or a hair remover in your home laboratory? These are some of the interesting experiments to be performed with three closely related chemical elements—calcium, barium, and strontium.

Sulphides of this trio of elements are easy to make, and exhibit odd properties. To prepare calcium sulphide, mix calcium sulphate (ordinary plaster of Paris will do) with charcoal. Place the mixture in a porcelain crucible and heat it with a Bunsen burner. Keep the crucible covered, so that the charcoal will not burn at the expense of the oxygen in the surrounding air, but of the oxygen contained in the sulphate. As a result of this "reducing" action of the charcoal, calcium sulphide is left in the crucible after the heating.

Take a pinch of the calcium powder you have obtained, and make it into a paste with water. This forms a hydrosulphide capable of destroying certain organic substances. Rubbed on the arm, the paste will remove the hair in only a few minutes' time. The experiment is perfectly safe, since the action is not caustic. Sulphides of barium and strontium, prepared from their respective sulphates in a similar fashion, have the same effect. Commercial depilatories also employ sulphide preparations of this type. The presence of a sulphide may be demonstrated by adding a drop of an acid, evoking the familiar and disagreeable odor of hydrogen sulphide gas.

Phosphorescence is another characteristic of the sulphides of calcium, barium, and strontium, and is applied in the manufacture of luminous paints. To show this property, the sulphide must be combined with other ingredients in just the right proportions, and the task of preparation is usually a delicate one. A simple method, however, is to heat a mixture of oyster shells and sulphur in a closed container, at a rather high temperature. The resulting mass of impure calcium sulphide should glow in the dark, immediately after being exposed to sunlight.

A curious experiment with calcium, popular among chemists of the seventeenth century, was performed by mixing a strong solution of calcium chloride with a strong solution of sodium hydroxide, or lye. The solid lump of white material that formed did not drop out when the vessel was inverted, and the ancient experimenters named the picturesque effect "the chemical miracle." You can easily repeat this historic experiment, guarding against failure by taking care to use concentrated solutions.

The experiment may be varied by dissolving the calcium chloride in alcohol instead of water. When this alcoholic solution of calcium chloride is added to the strong lye solution, a mass of white precipitate will form as before. Scraped from the container, it can be ignited, for the product is a form of solidified alcohol.

Because it greedily absorbs moisture from the air, calcium chloride in the usual form of anhydrous (dry) lumps should be kept in a tightly stoppered bottle. Its

Rubber Matting Protects Chemical Shelves

RUBBER matting, used to cover the shelves of your chemical bench, will prevent them from being marred by acids and other chemical agents from beakers and bottles. The matting may be purchased under the name of running-board material at automobile accessory supply stores. It is very inexpensive, and may readily be cut with an ordinary pair of scissors and fashioned into the desired shape and size. These mats also make convenient and ideal coverings when it is necessary to carry on chemical operations, such as filtering and making up solutions, away from the work bench. It costs but little to have three or four sizes of mats on hand.

The acid-proof matting can be easily cut to fit

affinity for moisture is made use of to lay dust on dirt roads; the chemical, sifted upon the road surface, forms water films that keep air currents from raising the dust. Calcium chloride is also used as a weed killer, literally dehydrating the roots of weeds.

So closely do barium and strontium resemble calcium in their behavior, that the three might well be termed the chemical triplets. All three, in their pure, metallic form, react even with the surrounding air and hence cannot be left exposed. They all interact vigorously with water, forming the hydroxides. Each of the hydroxides, in turn, combines with carbon dioxide to form the carbonate. Chlorides of calcium, barium, and strontium are all soluble in water; adding sulphuric acid to any one of them yields a white precipitate, the sulphate.

Another property shared by calcium, barium, and strontium is their common ability to produce insoluble oxalates of the metals, with solutions of soluble oxalates such as sodium oxalate or oxalic acid. Potassium chromate, added to solutions of compounds of any of the three metals, precipitates their chromates. Thus if potassium chromate solution is added to calcium chloride solution, calcium chromate, a yellow precipitate, is formed.

Knowing these facts, you will often be able to prepare a needed compound of one of these elements when it is lacking in your stock. Even a chunk of rock, or a piece of chalk, may augment your chemical supplies.

Limestone and marble—the latter a more or less crystalline mass—are both forms of calcium carbonate; so are pearls, sea coral, and chalk which consists of the shells of minute sea organisms. Still another and purer form of calcium carbonate is calcite, or Iceland spar; because of its peculiar property of double refraction, you can "see double" through its transparent, glass-like crystals. One proof that all these diverse forms of calcium carbonate have the same chemical composition is that hydrochloric acid, applied to any one of them, releases carbon dioxide gas, and the substance itself disappears to form a practically clear solution.

From the carbonates of calcium, barium, and strontium, you can easily prepare other compounds of the metals. Calcium chloride, for example, may be made by dissolving marble in hydrochloric acid. If the mineral witherite, a form of barium carbonate, is used instead, barium chloride is obtained.

An amateur chemist may purchase barium carbonate rather cheaply at drug stores, where it is sold for killing rats and mice; mixed with flour or other bait, it is considered a relatively safe poison. Here is a ready source of barium compounds for home tests. To prepare barium nitrate, for example, add the barium carbonate to dilute nitric acid (say, equal parts of the acid and water) until the effervescence of carbon dioxide bubbles ceases. Warm the solution and add more barium carbonate. If there is no more effervescence, all the acid has been acted upon and used up, and the solution contains the greatest amount of barium nitrate possible. Filter the solution and cool the filtrate, and colorless crystals of barium nitrate will crystallize out.

Barium and strontium produce a brilliant green and red light, respectively, when burned. Using simple apparatus and illuminating gas, these effects can be exhibited at home

The transparent substances through which you see the letters as double are crystals of Iceland spar, a pure form of calcium carbonate. The phenomenon is called double refraction

A glass rod or tube, held vertically against the lip of the beaker, makes decanting a liquid easy

Sulphates of calcium, barium, or strontium are obtained from any soluble compounds of the metals by adding sulphuric acid or a solution of any soluble sulphate, such as sodium or magnesium sulphate.

Making pure barium sulphate will give you an interesting acquaintance with the technique of decantation and the washing of precipitates. Start with a hot solution of a barium chemical, such as the chloride. Add sulphuric acid. Wait until the heavy white precipitate settles to the bottom, and then add more acid. Continue until no more white precipitate can be seen to form in the clear upper part of the liquid, showing that all the barium chloride has been converted into the insoluble barium sulphate.

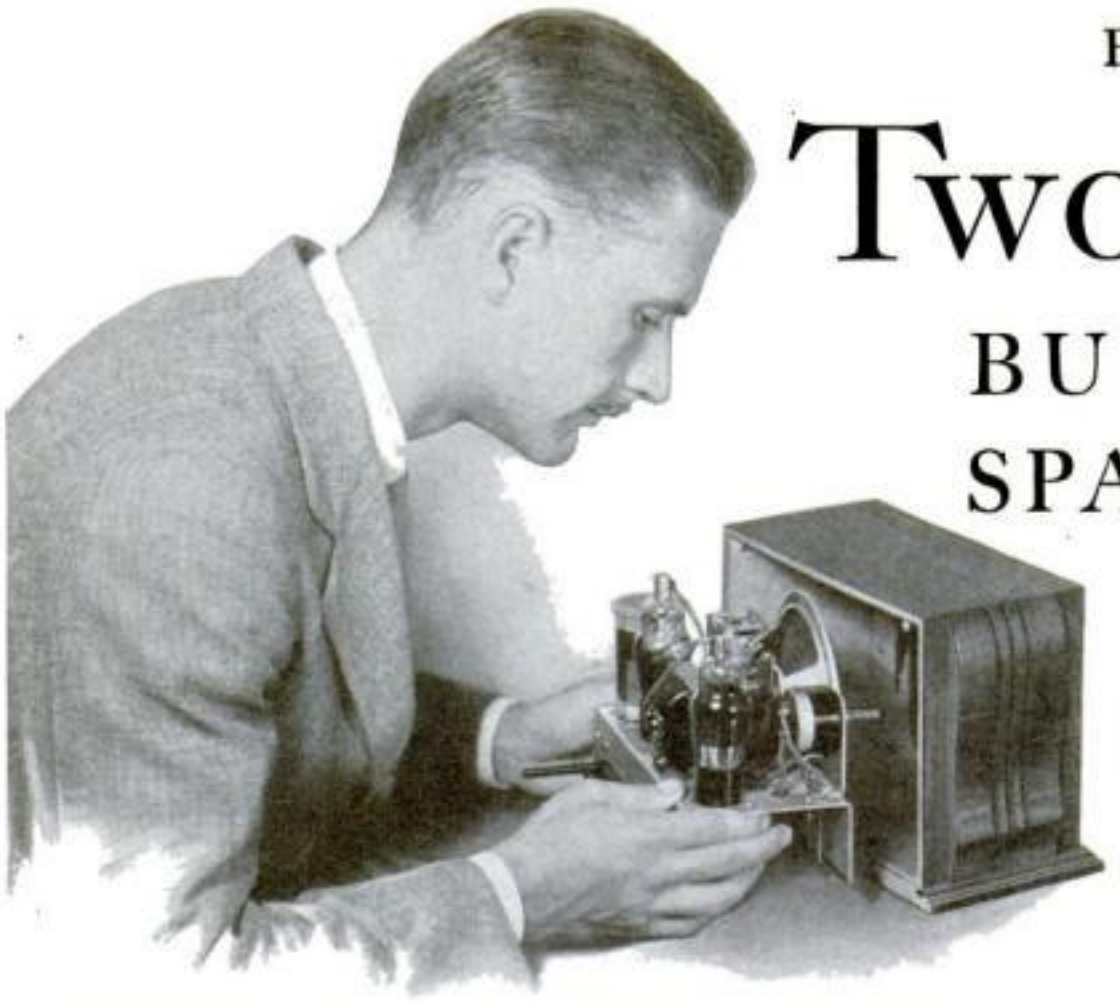
The finely divided precipitate obtained would pass right through ordinary filter paper, but it may be recovered by the operation known as decantation. First allow all the precipitate to settle to the bottom of the vessel. Then pour off as much as possible of the clear top liquid (which now consists of excess hydrochloric and sulphuric acids) without stirring up the precipitate. This is done by allowing the liquid to flow from the edge of the vessel, down a glass rod or tube held vertically against it. When the liquid has been drained in this fashion, fill the vessel again with water. Stir up the whole contents, let the precipitate settle, and pour off the liquid again. Repeat this a number of times. After about ten such washings, the barium sulphate may be allowed to dry, and is then removed and preserved in a bottle.

Alike in most respects, calcium, barium, and strontium differ strikingly in one thing—the colors that their compounds impart to a Bunsen flame in which they are placed. Calcium tinges the flame a yellowish red, barium produces a green color, and strontium a brilliant crimson. You can apply this simple flame test in the home laboratory to determine whether a certain chemical, for example, is a barium or a strontium compound.

Burning strontium chlorate or barium chlorate in illuminating gas provides a spectacular and beautiful experiment. The only apparatus needed consists of a bottle with its bottom *(Continued on page 114)*

EFFICIENT

Two-Tube Set BUILT WITH SPARE PARTS



A second-hand midget radio cabinet houses this efficient little receiver, the chassis being designed with the dimensions of the chosen cabinet in mind

CONSIDERED from any standpoint, this receiver, the "Duo-Duplex," is an excellent short-wave set for the beginner. First of all, it is easy to build; second, it is inexpensive; and third, it gives splendid results on either alternating or direct current and provides loudspeaker reception with volume to spare.

Its name, "Duo-Duplex," is derived from the fact that the receiver uses only two tubes, and each of these tubes—a 6F7 and a 12A7—is, in reality, two tubes in one. Thus, it is possible to obtain perfectly stable four-tube performance from only two tubes. Not in the least tricky, the connections to each of the tubes are standard in every respect and no complicated reflexing circuit is used.

As the circuit diagram shows, the receiver consists simply of a regenerative detector, two stages of audio amplification, and a rectifier. The 6F7 tube combines in one envelope a radio-frequency pentode and a triode. These two units are entirely independent of each other, except for a common heater and cathode. In this circuit, the pentode section functions as an exceedingly stable regenerative detector and is coupled through a condenser (C_6) to the triode section, which functions as the first audio stage.

The output of this dual-purpose tube is transformer-coupled to the 12A7 tube, which houses a half-wave rectifier and an audio power pentode in its single glass bulb. Separate connections to the units are brought out to the small, seven-pin base. Two six-volt, 0.3-ampere heaters are connected in series internally; one is for the rectifier, the other for the pentode.

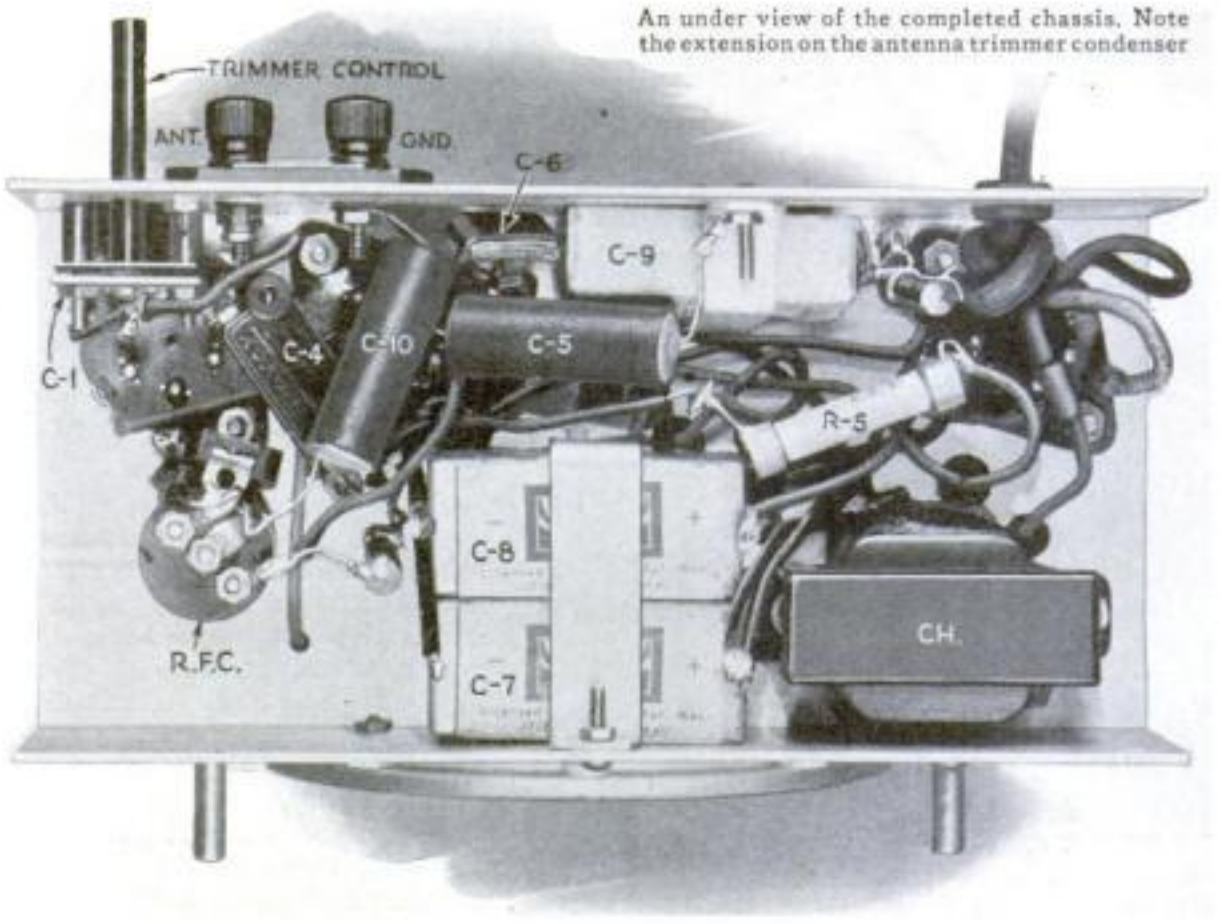
As connected into the circuit, the individual heaters of the two tubes are wired in series, thus requiring an overall filament voltage of approximately nineteen volts and a current drain of 0.3 amperes. This is obtained from the 110-volt power line by means of a built-in-resistance power cord. This type of cord contains the usual two wires for the 110-volt power supply and an additional resistor (R_6) wire wound over an asbestos core. One end of this resistor is joined to one of the terminals of the plug, while the other end terminates in a tinned sleeve that makes soldering into the heater circuit easy. The value of the resistor in this case is 315 ohms.

A separate resistor of this value mounted on the receiver chassis may be substituted, if desired, but the special line cord is recommended since the heat dissipated is considerable and, unless plenty of ventilation is provided within the set, trouble will result from deterioration of the filter condensers. For the benefit of those whose power lines may supply 220 or 240 volts, instead of 110, the value of the line-cord resistor in these cases should be 665 and 730 ohms, respectively. These values may be obtained by wiring a 350-ohm or a 415-ohm cord in series with the original 315-ohm cord.

Now for the intimate details. In order to make this receiver inexpensive, as well as easy to build, the number of parts has been kept to a minimum. Also, various types and brands of parts were tried in the original receiver to see just how much could be salvaged from old receivers, uncompleted circuits, and other odds and ends that gather dust in the radio experimenter's workshop. Parts resurrected from the writer's junk box, veterans of a forgotten age, with values differing as much as twenty percent from the original specifications, made no appreciable difference in the receiver's performance. If you have on hand any parts that are close to those specified in the list of parts, try them in the circuit before purchasing new ones.

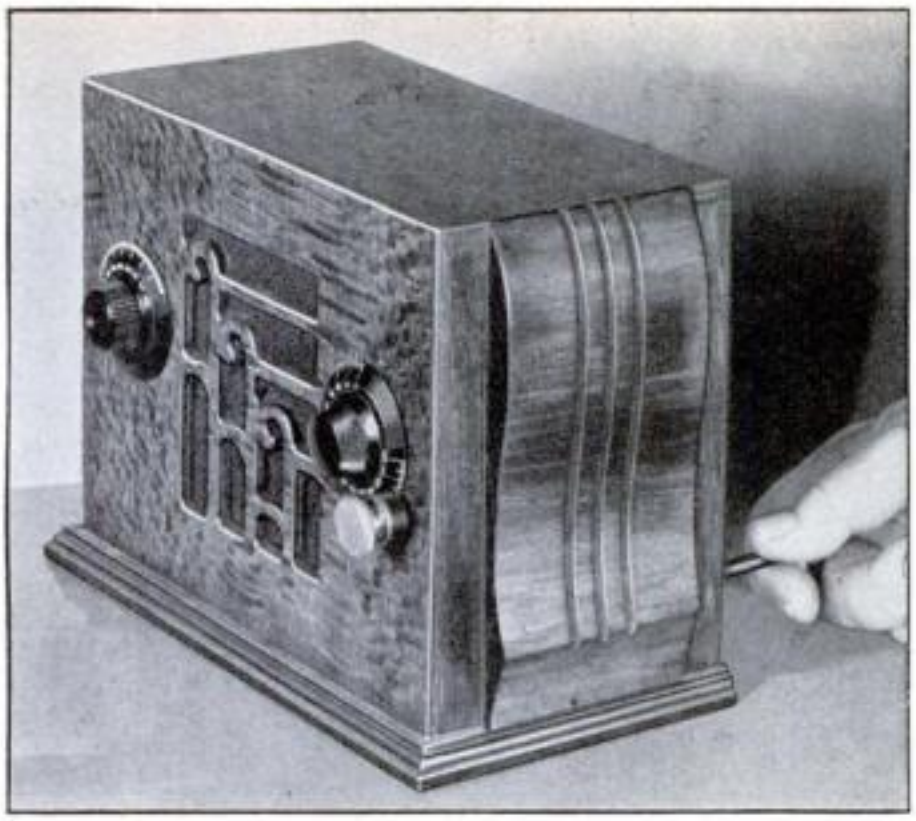
The only critical items in the receiver are the antenna condenser (C_1) and the regeneration (potentiometer) control (R_4). This is not surprising, however, since the antenna condenser determines the degree of antenna coupling, and therefore the amount of energy absorbed from the regenerative detector by the antenna, and the regeneration control provides the means of varying the voltage applied to the screen grid of the 6F7 tube.

The radio-frequency choke (R.F.C.) in the lead from the tickler coil (L_2) to the coupling condenser is a ten millihenry



An under view of the completed chassis. Note the extension on the antenna trimmer condenser

By J. B. CARTER



The postage-stamp-type antenna trimmer condenser is inside the chassis, with an extension rod for adjustment

Below, a top view of the chassis, showing the dual-purpose tubes that give stable four-tube reception

choke. This may be replaced with a unit of higher inductance, if necessary, providing the distributed capacity is small. Incidentally, a suitable choke can be made in the home radio workshop by winding about 900 turns of No. 34 single, cotton-covered wire in haphazard or scramble fashion on a short section of quarter-inch dowel rod.

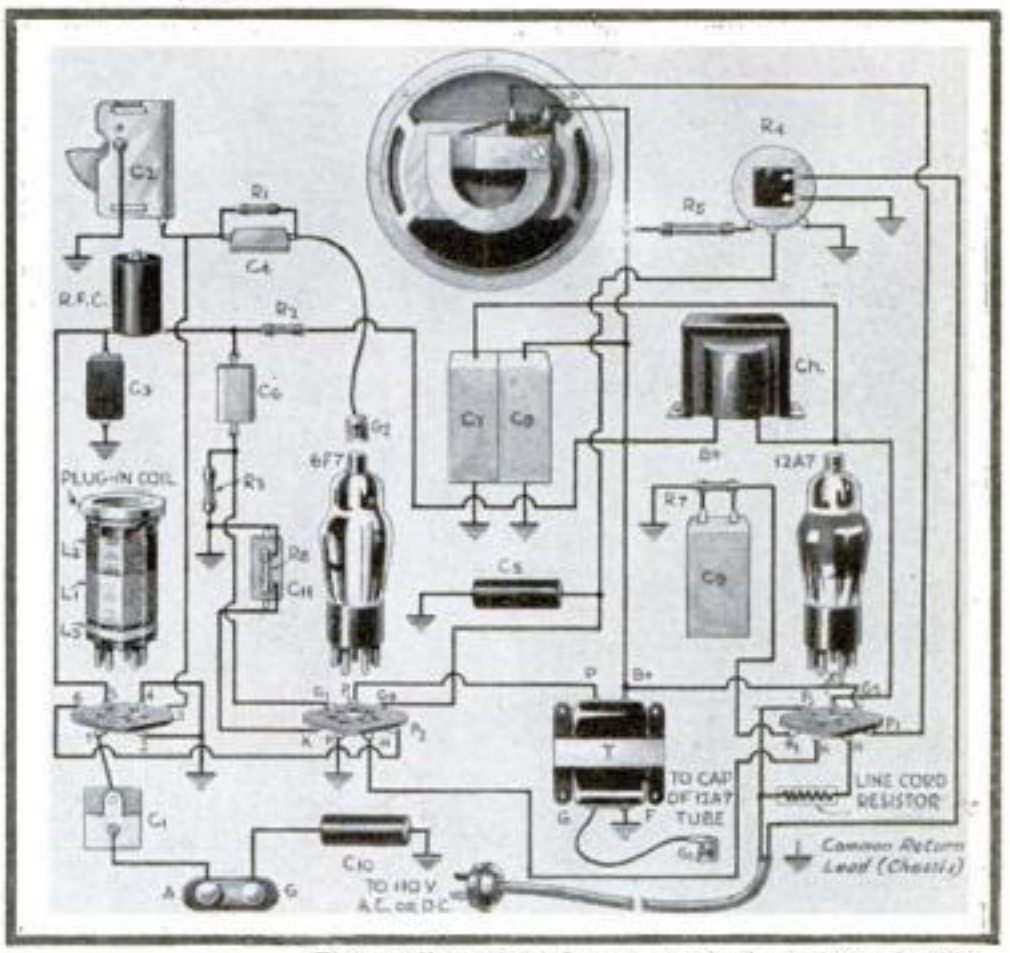
As can be seen from the photographs, the audio transformer used is of 1924 vintage and is rated as a one-to-three, step-up unit. Even with this antediluvian relic, the quality was fairly good. Of course, when a more up-to-date transformer was substituted both the quality and volume were improved.

Although a magnetic speaker is used, a small dynamic unit can be substituted. The field coil of the dynamic then will take the place of the filter choke (Ch.). The resistance of the choke or the field of the dynamic speaker should be between 300 and 500 ohms. If the resistance is much higher than this, the volume output level will be decreased.

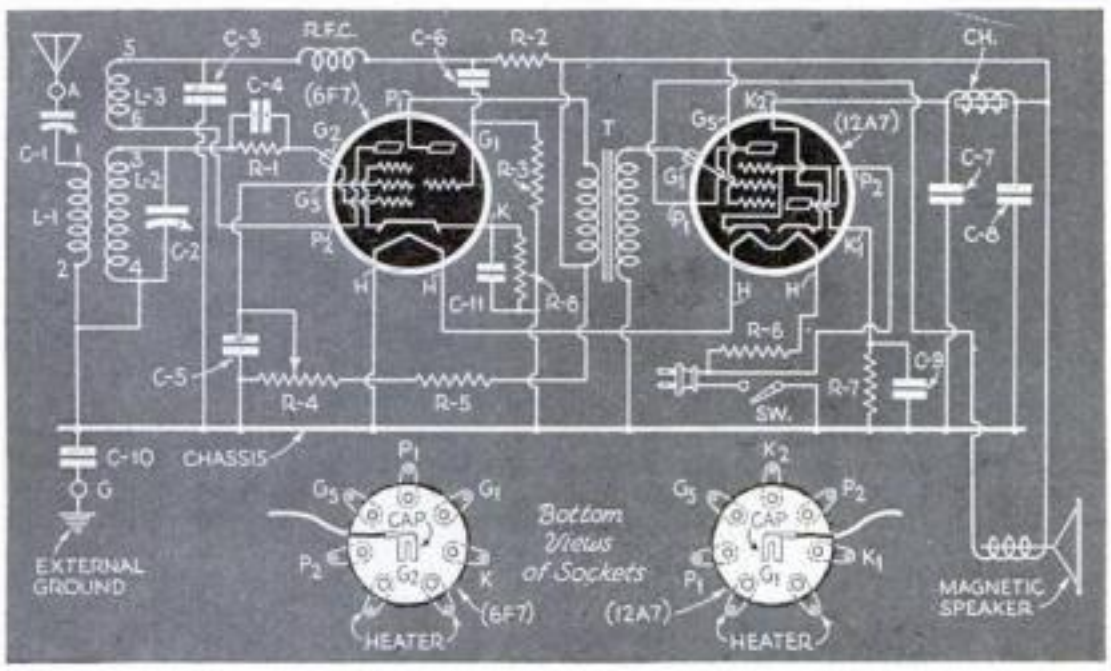
For complete success, it is wise to follow the general chassis layout as shown, although the actual dimensions will be determined by the size of the cabinet used. After all parts are securely mounted, the next step is the wiring. There are a few points to take into consideration when wiring the receiver if hum is to be kept at a minimum.

All leads carrying alternating current must be kept as far as possible from all grid leads. It is therefore advisable to place the heater leads first. They should be run around the edges of the chassis to leave room for the more important wires, such as grids, which are connected from point to point and should be as short as possible. Use only a good grade of solder and rosin flux and make sure that all connections are secure. Don't depend entirely on the metal of the chassis for return leads. A separate wire should supplement the chassis connections to insure low-resistance returns. Also, under no conditions must the chassis be connected directly to an external ground. The ground connection must be made through the fixed condenser C_{10}. If the receiver is used without the cabinet remember to insulate the metal chassis from any possible connection to the ground.

When the wiring is completed, check over the diagram and make sure that no mistake or omissions have been made. Then insert the tubes and one of the plug-in coils, connect the antenna, and plug the line cord into the power-outlet socket. Remember, on a direct-current line, there is a right and a wrong way to insert the plug. If the polarity is reversed, the set will not operate. On an alternating-current line, *(Continued on page 119)*

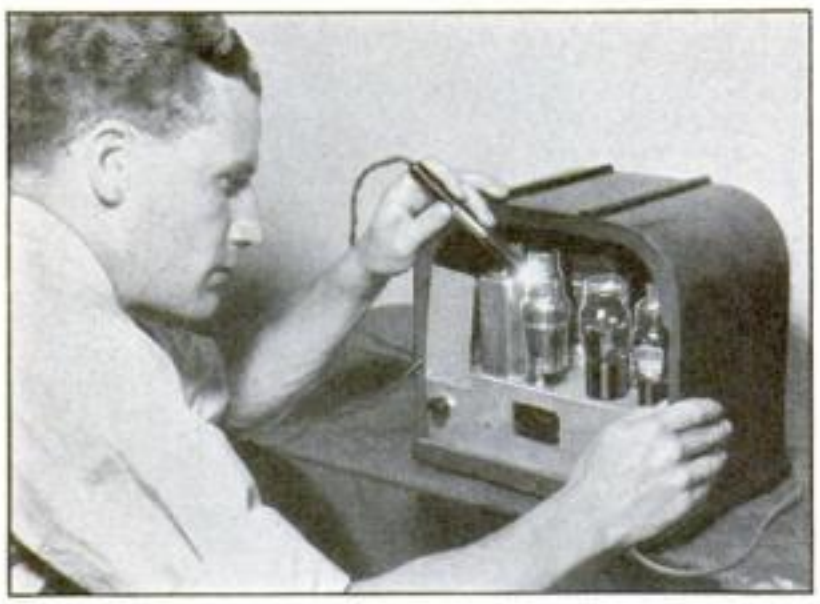


The small number of parts required, as shown in this picture diagram, makes the set inexpensive to build



The receiver consists of a regenerative detector, two stages of audio amplification, and a rectifier. Although only two tubes are used, each is in reality two tubes in one

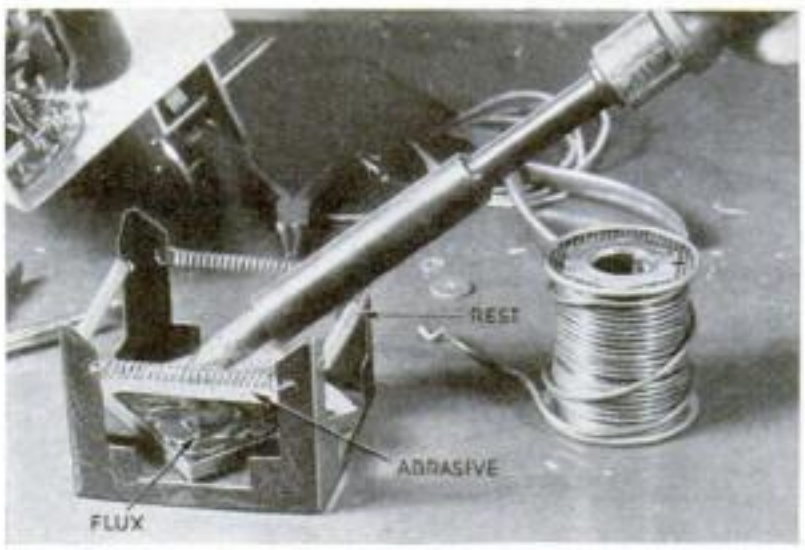
Radio Trouble Light Works on 110 Volts

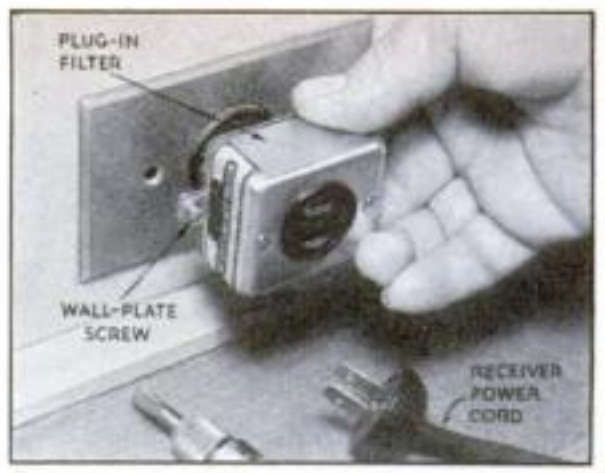


RESEMBLING a pencil, a recently developed midget radio trouble light can be plugged into any 110-volt socket. Small enough to fit into crowded corners, the light terminates in an ordinary pilot bulb. A resistance built into the power cord cuts down the 110-volt supply to six volts. The built-in-resistance power cord is similar to the one used with the AC-DC receiver detailed on the two preceding pages.

Soldering-Iron Rest Holds Flux and Cleaner

COMBINING three items in one, this inexpensive, lightweight soldering-iron rest includes flux and an abrasive, cleaning surface. Coiled springs stretched around the top edges support the iron when it is not in use, while two central trays hold the solid flux and the abrasive. An occasional rubbing first on the abrasive surface and then on the flux block not only keeps the tip clean but free from burns and pits.





Compact Power Filter Plugs Into Wall Plate

COMPACT and inexpensive, the power-line filter illustrated can be installed directly at the wall socket that supplies the power for your radio receiver. Provided with plug prongs and standard receptacle holes, it is simply plugged into the wall plate and the power cord from the receiver is in turn plugged into it. One of the wall-plate screws not only serves to hold the unit in place but also provides the necessary ground connection. Once in place, it eliminates any man-made static that would otherwise enter your receiver circuit through the power lines.

Storing Radio Tools

METAL fishing-tackle boxes make excellent radio-tool kits. They have a long compartment that will take a soldering iron, while the divided trays provide storage bins for small parts.

Condensers That Stack

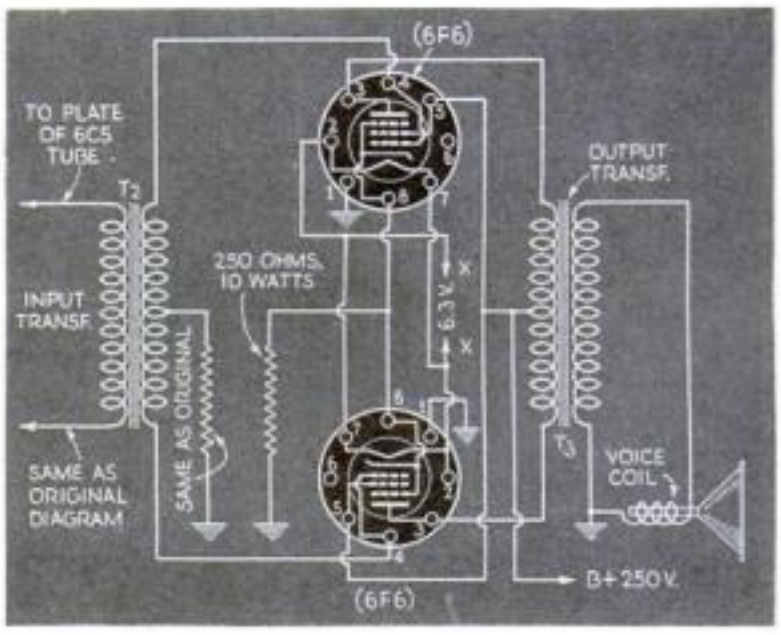
DEPARTING from the conventional design, a new flat, T-shaped transmitting condenser permits stacking to save space when several units are to be mounted in a crowded location. Mounting holes placed to one side of the main body are insulated and independent of the condenser terminals. When stacked, the terminals are free for individual or group mounting.

Glass Tubes Have Metal-Tube Bases

TO MAKE them interchangeable, many types of glass tubes are now being provided with the universal-type, "octal" bases used on the new metal tubes. This allows metal tubes to be used in glass-tube sets and vice versa. It also makes possible the use of the universal eight-hole sockets in glass-tube circuits. As described last month, all-metal tubes have uniform prongs, of the same size and arranged in the same pattern, which makes it possible to use a single type of socket for all types of tubes.

New Amplifier Circuit Increases Power of Metal-Tube Receiver

BY MAKING a few simple changes in the wiring of the metal-tube receiver described last month (P.S.M., Oct. '35, p. 52), the more powerful 6F6 all-metal tubes can be substituted for the 6D5 tubes specified. As shown in the diagram, the only changes in the parts, aside from the tubes, involve the output transformer (T3) and an additional fixed resistor. In place of an output transformer designed for push-pull '45 tubes, a unit constructed for use with push-pull pentodes ('42's) must be used. The additional resistor, a 250-ohm, ten-watt unit, is wired into the push-pull circuit as indicated. One other connection, involving the new pentode push-pull transformer, consists of connecting the center tap to the interconnected grids of the amplifier tubes. Since all metal tubes employ the same type of socket, an eight-hole unit, no physical changes in sockets need be made. However, since the 6F6 tubes are pentodes and not triodes, the additional connections shown must be made to the sockets. The radio-frequency and detector circuits of the receiver remain the same. Since the new 6F6 all-metal tubes are equivalent to the old '42 glass tubes, a noticeable increase in volume will be obtained by this arrangement. Incidentally, the 6F6 tube is used in preference to the 6D5 in receivers of commercial design.



Question: Is the solar day the most accurate measurement of time?—A. O. T., Washington, D.C.

Here's *the* Answer

A.—THE most accurately timed day is the sidereal or star day. The length of such a day is determined by the interval between two successive appearances of a fixed star on any chosen meridian. It is about four minutes shorter than the mean solar day so that there are approximately 366 sidereal days in a year of 365 solar days.

To Keep You Well

P. M. S., ELIZABETH, N. J. There are, in round numbers, 150,000 physicians, 61,000 dentists, and 60,000 drug stores in the United States.

A Puny Start

Q.—IS IT true that a kangaroo is as small as a mouse when it is born?—C. B. I., Sacramento, Calif.

A.—KANGAROOS are less than an inch long when born. They are blind and without fur. Usually only one kangaroo is born at a time. The mother's pouch affords the young its needed protection.

Can't See Undersea

P. T., WATERBURY, CONN. The normal human eye, developed for vision in the air, becomes a poor optical instrument under water because the contact of the water with the cornea, the transparent part of the eyeball covering the pupil and iris, robs it of about two thirds of its refracting power.

It's a Good Wind

S. B., SAVANNAH, GA. The trade winds cover about one twentieth of the earth's surface. These regularly flowing masses of air, moving from the tropical areas of relatively high pressure to the equatorial belt of low pressure, form a current about 1,000 miles wide and extend for a distance of 2,000 miles. In the Northern Hemisphere these winds blow toward the equator from the Northeast and in the Southern Hemisphere from the Southeast.

Setting the World's Clocks

Q.—WHEN was a world standard of time agreed upon? Also, when was it legalized for use in this country?—C. W., Columbia, S. C.

A.—A WORLD standard of time was adopted at an international congress held at Washington, D. C., in 1884. Standard time was inaugurated in this country in March of the same year and came into use without any legislative action.

A Case of Fish Eat Fish

O. M. T., HAVERHILL, MASS. The biggest loss of trout in stocked streams is not due to fish-eating birds but to other fish such as sticklebacks, sculpins, suckers, sunfish, catfish, and even trout themselves. There is also a heavy loss of trout fry from water snakes, salamanders, crawfish, leeches, and larvae of certain beetles.

To Restore Faded Writing

Q.—I HAVE an old manuscript on which the writing has faded so that it is no longer legible. Is there any way in which I can restore the writing?—N. S., Richmond, Va.

A.—THE faded writing may be restored by rubbing the manuscript with a solution of ammonium sulphide or hydrogen sulphide. The restoration is not permanent but the writing can be traced with India ink to make it so. This procedure will not be effective if the original writing has been done with an aniline ink.

At Home Anywhere

Q.—WHAT animal is found over the greatest range of the world's areas?—H. N., Racine, Wis.

A.—PROBABLY no other living animal has a wider range of habitat than the snail. Snails are found above the snow line in the Himalaya Mountains and at all intermediate altitudes down to sea level. Apparently not content with this land record, they have invaded the sea and specimens have been brought up from a depth of 16,000 feet below the surface of the ocean.

Cleaner for Wall Paper

Q.—IN YOUR country, you have some excellent wall-paper cleaners. Would you be so free as to tell me how to make such a cleaner?—H. N., Odense, Denmark.

A.—A WALL-PAPER cleaner may be made as follows: Mix into a dough one pound each of rye flour and white flour. Bake partially and remove the crust. To this mass, add one ounce of common salt and one-half ounce of powdered naphthalene. Mix and add one ounce of corn meal and one-eighth ounce of burnt umber. After the doughlike substance has been thoroughly mixed, a mass of the proper size to be grasped in the hand should be drawn across the surface to be cleaned, in one direction only.

The Hard Part Is To Find It

Q.—WHAT metals are found in an uncombined state?—J. H. H., Denver, Colo.

A.—GOLD and platinum share the distinction of being the only metals customarily found in nature in the uncombined state. Only a few other metals, such as silver and copper, and these rarely, are found in the free metallic state. Gold, on the other hand, is seldom found in any other form.

A Lot of Hellos

P. W., BOSTON, MASS. It is estimated that more than 75,000,000 telephone conversations take place daily in this country. This is at the rate of nearly 900 for every second.

Some Long-Lived Birds

C. A. A., HARRISBURG, PA. The maximum ages attained by some long-lived common creatures are: swan, 150 years; golden eagle, 104 years; raven, 100 years; parrot, 100 years; goose, eighty years; sparrow, forty years. The average life span, of course, is somewhat less in each case.

Rivers' Tribute to Atlantic

Q.—CAN you tell me the volume of water that rivers empty into the Atlantic Ocean each year?—O. M. R., Seattle, Wash.

A.—IT IS estimated that the yearly discharge of rivers into the Atlantic Ocean is 3,400 cubic miles of water—equal to about one half the river discharge of the world.

Biggest in the Air

Q.—WHAT is the largest species of water birds?—J. J. A., Portland, Maine.

A.—THE wandering albatross is the largest of all water birds. It has, in fact, the largest wing expanse of the entire bird kingdom—measuring ten to fourteen feet, tip to tip. The bird is noted for its extended flight. It actually lives on the wing, alighting on the water only to catch a fish or pick up a piece of refuse from a ship. When the bird takes to flight from the water, *(Continued on page 117)*

"Probably you didn't know that a coating of wet leaves on a road is pretty nearly as treacherous as a sheet of ice," said Gus, as he started to remove the wheel and take out the broken bearing

Gus says: Quit Your *Skidding*

By MARTIN BUNN

"YOU may have been beautiful on a tree, but you're only a danged nuisance now," muttered Gus Wilson, veteran mechanic of the Model Garage, as he vigorously wielded a broom on a layer of damp leaves stuck to the concrete in front of the gas pump.

"Morning, Joe," he called to his partner, as the latter arrived with his lunch kit swinging at the end of his skinny arm. "Better dump a quart of oil in the service car and see that there's gas in the tank. With the ground covered with leaves, and that rain last night, I have a hunch we're going to get some calls today."

"What have the leaves and the rain got to do with service calls?" Joe asked. "It's all dried up now, anyhow."

"Come out with me on the first call we get and you'll see," replied Gus, as he went on with his sweeping.

Before an hour had passed, the phone bell shrilled and Joe popped out of his little office.

"You win, Gus! Let's go," he called as he climbed into the service car and motioned to the boy to swing the doors open.

"Drive down Center Street till you come to the bend just beyond Locust Avenue," Joe directed, as Gus piloted the service car out into the street. "Mrs. Dean phoned she's barged right off the pavement onto somebody's yard—says the steering gear's gone haywire. Nobody's hurt, she says."

"Maybe it is the steering gear, but I'll bet you a cookie it isn't," said Gus.

When the garagemen arrived on the scene, Mrs. Dean, pale and trembling, was staring fixedly at the front wheels of the car. "Oh, Mr. Wilson! Can you fix it right away?" she gasped, as Gus climbed out of the service car. "Mr. Dean will be so angry with me if he finds out I've had an accident. You know I haven't been driving long."

"Don't worry, Mrs. Dean. We'll take care of things," Gus assured her, as he walked back up the road and critically examined the tracks the wheels had made in going off the road.

"What did I tell you, Joe!" demanded Gus, pointing to where the tell-tale sliding streak of the tire started on a part of the road that was covered with wet leaves.

"Did you put on the brakes as you came down the grade here, Mrs. Dean?" he asked.

"Only the tiniest little bit," she replied. "I wasn't going fast, and I wouldn't have put on the brakes at all only I was going to stop at Mrs. Foster's, three houses farther on."

"That's funny," said Gus. "You shouldn't have gone into such a bad skid unless something is binding on that wheel. I'll take a look."

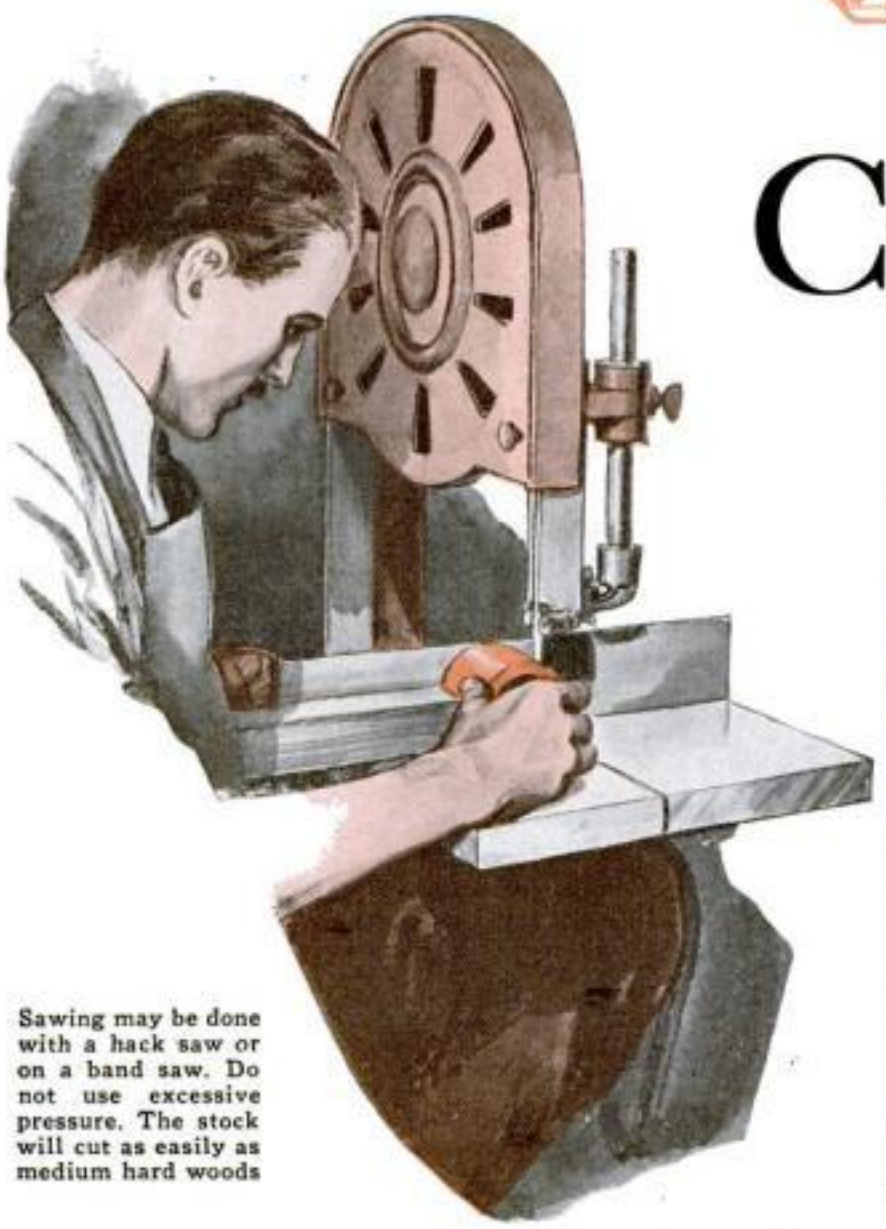
Gus got out the jack and a wide piece of board to keep it from sinking into the soft turf. As soon as the tire was clear of the ground, he grabbed the wheel and gave it a vigorous twist. It turned stiffly with a rumbling, grating sound.

"Humph!" Gus grunted. "Roller bearing broke—doesn't happen often these days. Drive down to the shop, Joe, and get a new set while I take these out."

"Then it wasn't the steering gear, after all!" exclaimed Mrs. Dean. "And it wasn't even my fault, was it, Mr. Wilson? Surely I'm not to blame if that roller thing busted, am I?"

Gus laughed. "Not directly, Mrs. Dean. But you wouldn't have landed on this lawn if you hadn't put the brake on just when you did. Probably you didn't know that a coating of wet leaves on a road is pretty near as treacherous as a sheet of ice. And you're most likely to get into trouble on a day like this, when everything looks perfectly dry. It rained last night and, although the top leaves are dry, they're wet and slimy underneath. The tire sticks to the top leaves all right, but the wet, slippery ones beneath act like a rug on a polished floor. Putting on the brake, even just a little, started the slide because of that stiff bearing, but, even if the bearing had been O.K., you'd have landed here just the same if you'd been going a bit faster and put on the brake a bit harder."

"The mere thought of skidding makes me feel faint and shaky," said Mrs. Dean. "This is the second one I've had. You feel so absolutely helpless when the car starts to slide and you can't stop it. And there doesn't seem to be any way of learning what to do about it." *(Continued on page 118)*



Sawing may be done with a hack saw or on a band saw. Do not use excessive pressure. The stock will cut as easily as medium hard woods

HOW TO WORK WITH

Cast Resins...

A marvelous new material for amateur handicraft

Typical resin castings. The flat plate is a piece of ¼-in. sheet stock. The others, from left to right, are earring, ring, pin (note the Scottie shape), fancy dress-clip, the bracelet material

Finished bracelet and clip. These are the same pieces seen in process in later photos. The bracelet has been left half carved to show the difference between the smooth and decorated surfaces

CAST synthetic resins are those brilliantly colored, jewel-like materials used for making costume jewelry, table lamps, clock cases, game sets, and hundreds of other items in which color, translucence, fine permanent finish, and ease of working are important. Unlike most synthetic plastics, they can be machined in the home workshop, requiring only ordinary skill and the familiar tools used to work hard woods or light metals.

In the hands of the clever home craftsman, they offer unusual opportunities to produce beautiful objects—far more colorful and enduring than most woods, far more appealing to see and touch than cold metal. Until recently their purchase was restricted to manufacturers only, but today a number of firms are in a position to supply the home shop owner with either work kits or single castings.

Cast-resin materials are made in giant kettles as a liquid resin and are then cast in lead molds and placed in vulcanizing ovens to harden. When ejected from the molds, they appear in the form of rods, tubes, sheets, or any of several hundred special shapes. Thus there is very little waste in machining; the craftsman merely chooses the particular casting which most nearly conforms to the shape he intends to develop.

Choice of type and color is also extremely wide. Castings are made in solid colors, in mottles like marble, in light translucent shades, and in completely transparent, water-clear form. Transparent castings are sometimes flaked with tinsel in gold or silver. More than 300 shades and colors are manufactured, though not all of these are available to the amateur craftsman.

In working cast resins, almost every process possible with wood or brass is equally easy to apply. They may be sawed, drilled, threaded, carved, sanded, ground, turned, polished, and cemented. In most cases the process compares exactly with that used in working hard woods. In some instances slight differences obtain. Probably the easiest way to learn how to work cast resins is to follow the process of making one or two pieces of costume jewelry, for jewelry calls for the use of almost every operation mentioned.

One of the accompanying photographs shows several jewelry castings. The large cylinder is a bracelet section, ample for making from three to six bracelets. It is cast so as to be of a size that will slip readily over the average woman's hand.

The first operation calls for sawing off a section to the required width, which will vary, with your design, from ½ in. to as much as 1½ in. If a hack saw is used,

You Can Learn Quickly to Use Plastics by Making a Few Rings, Pins, Dress Clips, and Bracelets with Ordinary Tools—Many Colorful Projects Are Possible

By ALBERT Q. MAISEL

apply only light pressure, to let the powdered chips clear. Place a block of wood within the cylinder when locking it in a vise, so that it won't break or crack under the pressure. If a band saw is available, the cut may be made in a few seconds. The saw should not run faster than 280 ft. a minute, to insure against scorching. If the work is pushed slowly past the blade, a neat, almost polished cut will be secured.

Having cut the section, place it on the expanding jaws of a chuck for turning. If no such chuck is available, turn a wood block to a slight taper, so that the section will slip over it to a tight fit. Lock this block between centers on the lathe, with the cast-resin section in place, and use an ordinary wood-turning chisel, taking a light bite. Hold the chisel edge at or slightly below center, but have the handle higher, as illustrated. The material will machine with a shaving, instead of crumbling like wood.

Some craftsmen who have been working with this type of material prefer to grind their chisels with a bevel on both sides, and if you wish, you may grind a chisel or an old file in that way and experiment for yourself. Start turning with the handle raised well above the cutting edge, and lower it by degrees until you find the angle that gives the best shaving.

The bracelet is now ready for carving. This is done with a regular bench spindle, attached to the power end of your lathe or to any rigid revolving head. Old dentists' drills and cutting wheels or burs can be used if the proper carving tools are unavailable. Professional carvers work from memory, centering their designs by eye. The amateur will do well, however, to sketch his design on the turned bracelet in pencil before carving. Carve the deeper cuts first, then the shallower ones. Take care not to make your cuts too deep or you will weaken the piece and possibly fracture it. After carving, wash the dust away in cold or lukewarm water, using an old toothbrush to clear the crevices.

There are two steps to the polishing process: first, ashing or pumice polishing, and second, waxing. If you have a 6-in. buffing wheel of the muslin-disk type, operate it at a speed of about 3,000 r.p.m. If your wheel is larger or smaller, adjust the speed to compensate accordingly.

In ashing or preliminary polishing, place powdered pumice and water in a shallow pan under the buff so that the wheel just touches the mixture. As you hold the piece to be polished against the wheel, apply some of the "mud" by hand just above the piece, doing this as often as necessary.

Final or wax polishing is done with a similar wheel, using standard waxing compounds or a better grade of powdered floor wax. After polishing, finish off with a soft, dry buffing.

To make a ring, follow the same processes as in the case of the bracelet. Ring rods (such as the second from the left in the photograph of the raw materials) are cast with a center or finger hole having a slight taper. Thus a 6-in. rod will provide about twelve rings having finger holes of various sizes to fit varying hands.

After sawing off the ring section, place it in a vise with the flat face downward, and cut back on either side with a hack saw so that the band between and in back

WHAT YOU SHOULD KNOW ABOUT Cast Resins

THE MATERIAL. Synthetic resins are cast into rods, tubes, sheets, ring stock, bracelet stock, and several hundred special shapes. They are available in all solid colors, light translucent shades, water clear like glass, and in an endless variety of mottles.

PROJECTS. Costume jewelry, table lamps, clock cases, game sets, book ends, novelty boxes, candlesticks, salt and pepper shakers, jewel cases, trays, photo frames, coasters, handles and ornaments for furniture, desk sets, and innumerable novelties.

OPERATIONS. The material may be sawed, drilled, turned, threaded, carved, sanded, ground, polished, and cemented.

TOOLS. Lathe, jig saw, grinder, polishing head, carving spindle, hack saw, files, and other tools ordinarily used for hard wood or soft metal.

Polishing the carved and washed bracelet. A high-speed muslin disk wheel is used, the wet pumice "mud" being placed at intervals above the object being polished on the wheel

Turning a bracelet on a slightly tapered wooden mandrel. An ordinary, straight-edged wood chisel removes long shavings

Carving is done with a high-speed spindle held at right angles to the cut. Only the lightest pressure is needed to make the cuts

Here are a few of the thousands of designs that may be made from simple resin castings. With this material you can work out countless ideas

of the fingers will be thinner than the carved face. Then carve, wash, polish and wax just as with the bracelet.

Clips and pins may be made in two ways. A number of shapes are available in standard rodlike sections. These may be sawn off to the desired thickness and then beveled on a sanding belt, a grinding wheel, or with sandpaper, and subsequently carved and polished. If, however, a special shape is desired, sketch it in outline on a piece of paper, paste this on a section of sheet stock—usually ¼ in. thick—and then cut it out on a jig saw. Either a hand fret saw or a power scroll saw can be used. After this, follow the practice previously outlined.

In making earrings it is best to place the round earring rod in a lathe chuck and turn its end to the desired shape before cutting it away from the excess rod. This is necessary because of the small size of the stock.

On pins, clips, and earrings, it is necessary to attach metal parts called "findings." These are of standard types and can be purchased from jewelers or suppliers of cast resins, or may be taken from cheap, dime-store jewelry.

The riveted kind require drilling with a fine drill and the insertion of small self-tapping screws to attach the finding to the cast resin. The simpler pressed-in type can be attached in one or two minutes by the following method: Turn an electric iron over to form a flat, hot table. Heat the back surface of the pin, clip, or earring sufficiently to soften it by holding it against the iron, but take care against overheating, which will spoil the coloring. A heat of about 230 deg. F. is ample. When the piece is softened slightly, the attachment pins of the finding can be forced into the cast resin by applying slow and steady pressure. If no better tools are available, place the two parts in a vise and tighten slowly. Do not hammer the pins into place; a strong hammer stroke may deform the softened resin.

When the finding has been forced into place, the cooling resin will contract over the pins, and a tight and permanent bond will be secured.

Many other types of jewelry may be made by the ingenious craftsman. A study of the designs on display in department stores will suggest many ideas. Link bracelets can be made by cutting the links from two colors of rod stock, drilling these, and then threading them with elastic cord.

Two-color clips can be made by carving or cutting sections to an exact fit and then cementing them in place. Cast-resin dealers supply special cements for this purpose, as it is difficult to stick these materials together securely with any of the adhesives ordinarily used in the home workshop. It pays to obtain the special cement recommended by the manufacturer of whatever make of plastic you happen to be using. For temporary attachment, however, as when fastening a sheet or block of the material to a piece of wood so that it may be screwed to a faceplace without leaving holes in the cast resin, liquid or hide glue may be used. It will not be difficult to remove the material afterwards and wash off any remaining glue.

If transparent, water-clear resins are used—they cost about twenty percent more than the colored types—they can be carved from the back and painted with water colors to give flower or other designs.

A second color may be added to front-carved colored pieces by using sharp and comparatively shallow carving and then, after pumicing, applying a thick film of water color. This should be followed, after the color is fairly dry, by a light dry buffing, which will remove the color from the surfaces and leave it only in the carved grooves.

If you would like to see more articles on cast-resin craftwork published in future issues of Popular Science Monthly, *please send a post card to the Home Workshop Department. Bear in mind that this type of modern plastic is not the same as celluloid, similar as the materials are in general appearance. A number of articles have already been published on celluloid work (see P.S.M., Jan. and Oct. '34; Mar., May, June, Sept., and Oct. '35).*

Wax polishing a carved clip. Here again, the higher the speed, the better the polish. This is followed by a short dry polishing

Flat pieces are jig-sawed from sheet stock. The design is cut from paper and pasted on the stock. Caution: Make sharp turns slowly

When cast-resin projects require to be beveled, the work can be done on a wheel, as in this instance, or by hand with sandpaper

SPECIAL DRAWER BUILT INTO BASE OF DRILL

WHEN setting up a sensitive drill, I built a wooden base with a drawer to hold an assortment of drills from 1/16 to ¼ in. by sixteenths, as well as three sizes of center drills. The bottom of the drawer has a shallow groove for each size drill to rest in.—T. O.

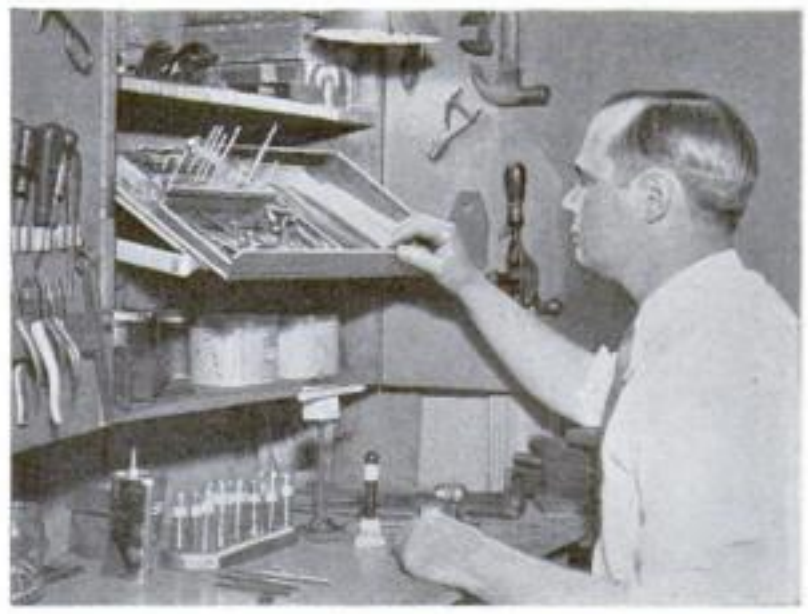
CEMENT CLEANS OILY FLOOR

AFTER some heavy machinery had been moved in a large pumping plant, it was found that the concrete floor beneath was badly stained from drippings of oil and grease. Several methods of cleaning failed, and a suggestion was finally made that ordinary cement be spread over the soiled section. This was done, the powder being sprinkled over the surface only in sufficient quantity to cover it well. Every other day for a week it was stirred up with a brush.—NESTOR BARRETT.

TOOL TRAY SWINGS OUT OVER BENCH

DRILLS, files, and measuring and lay-out tools, which are in constant use, may be reached more conveniently if kept in a tray that swings forward over the bench as illustrated.

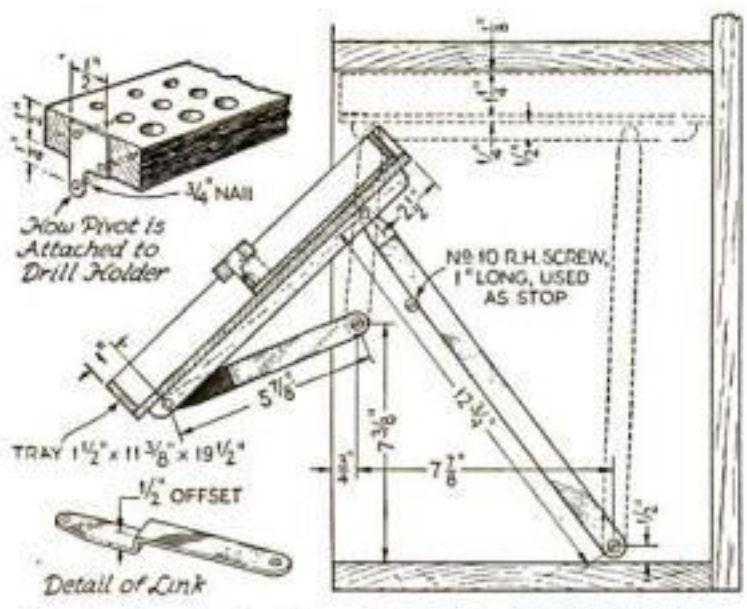
When work is to be done, the tray is pulled out of the cabinet and swung forward and downward to a stop. The pivoted drill holder is then turned so the holes face upward, and the various punches, scribers, and similar tools are set in their holes ready for use. At the conclusion of work, the drill holder is swung down, and the small tools are laid in their special tray. Then the main tray is pushed back into the space at the top of the lower shelf compartment, which usually is not occupied by anything in the average tool cabinet.



The tray is pulled out of the tool cabinet so that it rests at an angle, with drills and other small tools readily accessible

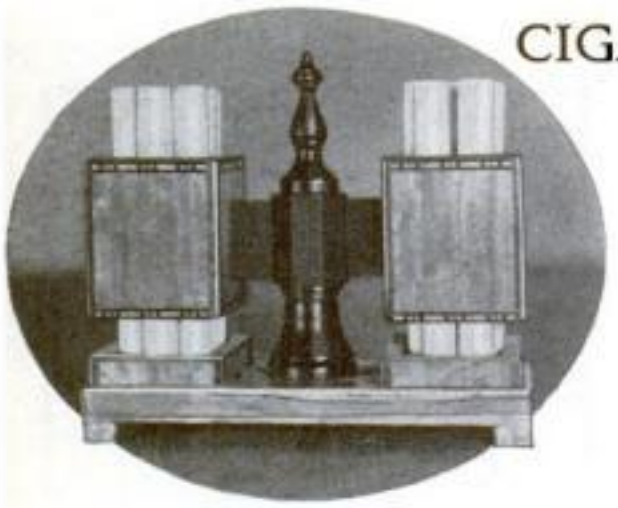
The tray can be designed to suit the space available. The one illustrated required the following materials: Wood—1 pc. ¼ by 11⅜ by 19½ in. for base; 2 pc. ¼ by 1¼ by 19½ in. for sides; 2 pc. ¼ by 1¼ by 10⅞ in. for sides; ¼ by 1-in. partitions as desired, or cigar boxes; 2 braces ½ by ⅞ by 10¾; 1 pc. ½ by 1¼ by 8 in. for drill holder. Steel—2 pc. 1/16 by ¾ by 6 in. (with ½-in. offset) for links; 2 pc. 1/16 by ¾ by 13⅞ in. (with ½-in. offset) for links; 2 pc. 1/16 by ½ by 1⅜ in. for drill-holder plates; 1 pc. 1/32 by 15/16 by 8½ in. for small tool tray.

To serve as the main tray pivots, eight ½-in. No. 8 roundhead wood screws are needed; for stops, two ⅞-in. No. 8 roundhead screws; and for drill-holder pivots, two ¾-in. nails.—W. HEINZMANN.



How the tray is pivoted, and a detail of the drill holder, which turns down so that the tray can be pushed into place

CIGARETTE HOLDER MADE FROM SCRAP WOOD



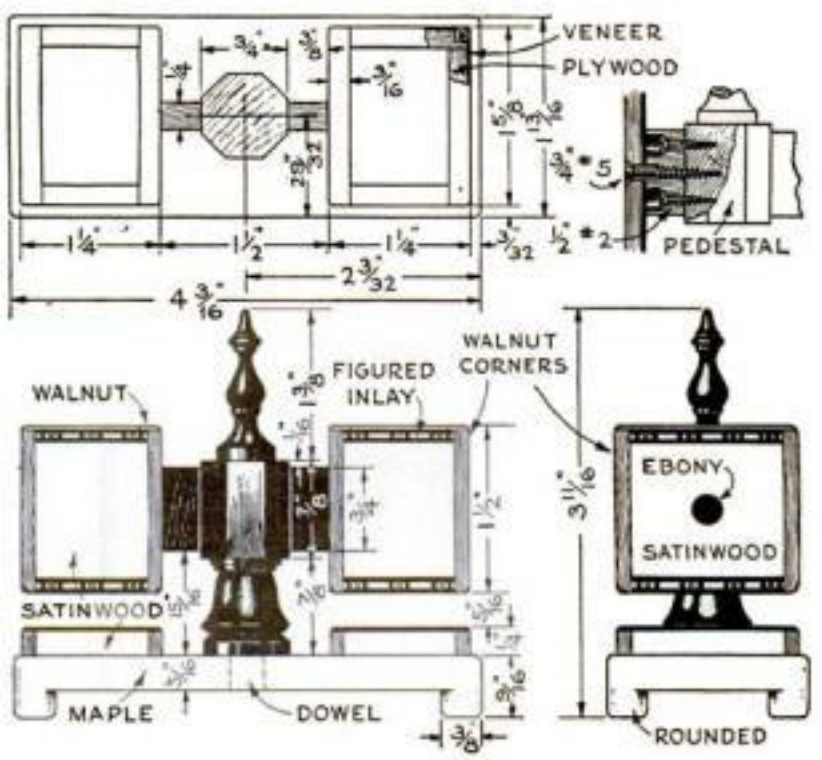
Left-over pieces of beautiful hardwoods provide the material for this unique container

FROM a few scraps of fancy hardwoods, you can make the attractive little cigarette holder shown above. First construct the two containers, open at top and bottom, of 3/16-in. basswood plywood. Rabbet the corners and set in the ⅛-in. square walnut pieces, letting them project 1/16 in. Glue on the inlays, top and bottom; then the satinwood sides, which are 1/20-in. thick veneers. The rim on the base directly under each of these holders is made the same way. Glue walnut strips on the top edges of the holders and rims to hide the unfinished edges of the plywood.

Turn the pedestal from ebony and shape the octagonal part by hand. The base in this instance happens to be a piece of freak maple found in an ordinary cake board that cost ten cents. The remaining details and method of assembly are made clear in the drawings.

The only filler or stain necessary is on the walnut, therefore it pays to fill and stain the walnut before you put it in place. On the outside apply two coats of white shellac, thinned with alcohol and sandpapered between coats. Two coats of rubbing varnish will then give a good finish if finally rubbed with rottenstone and water. Stain the inside of the holder dark brown and give one coat of white shellac. When all but the last coat of finish is applied, assemble the entire job.

The reason there is a gap between the holder and the rim is to give the design distinction and make it easier to clean off the tobacco that collects from the cigarettes.—THOMAS B. OWENS.



For information about our blueprints, turn to page 80.

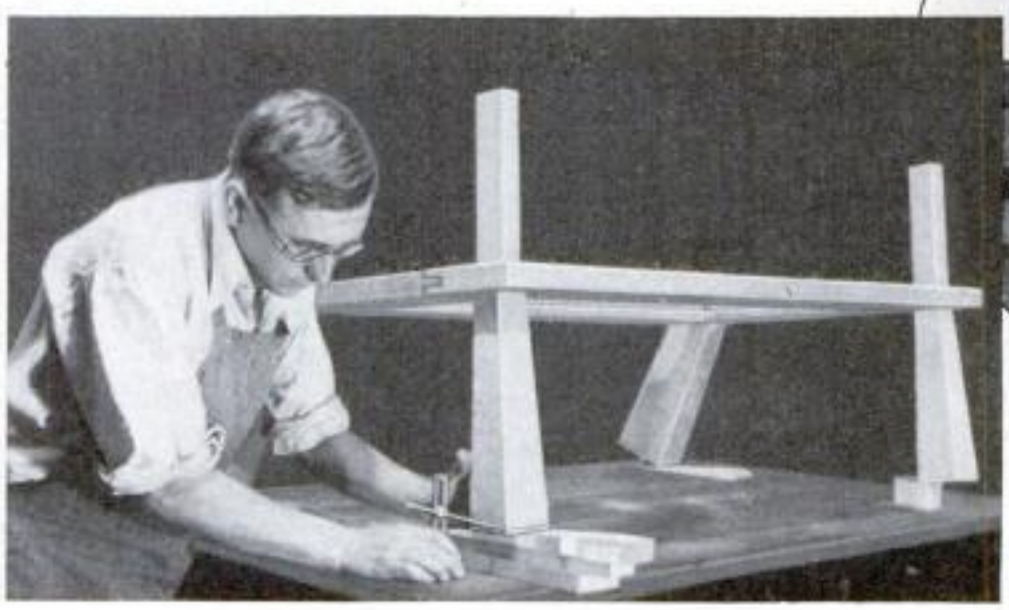
MAPLE Love Seat

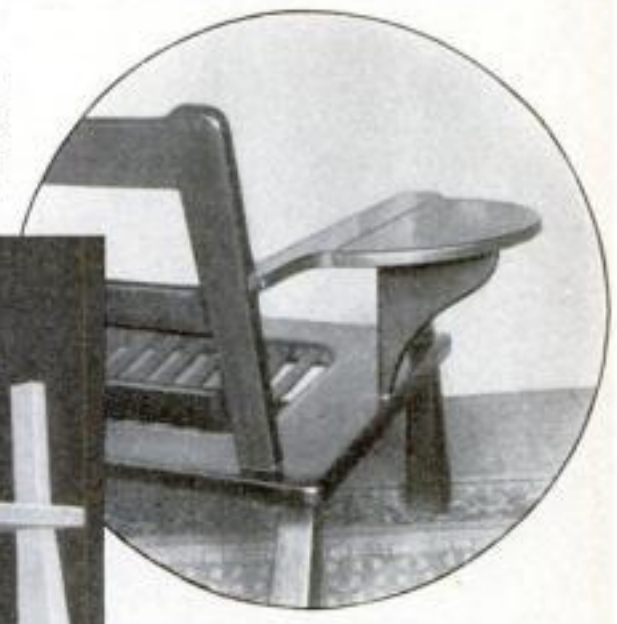
COMBINES SIMPLICITY, BEAUTY, AND COMFORT

Although of Early American design, this piece is quite modern in comfort. It has inner-spring seat cushions and stuffed back cushions

A Special Design in Early American Style

By DONALD A. PRICE





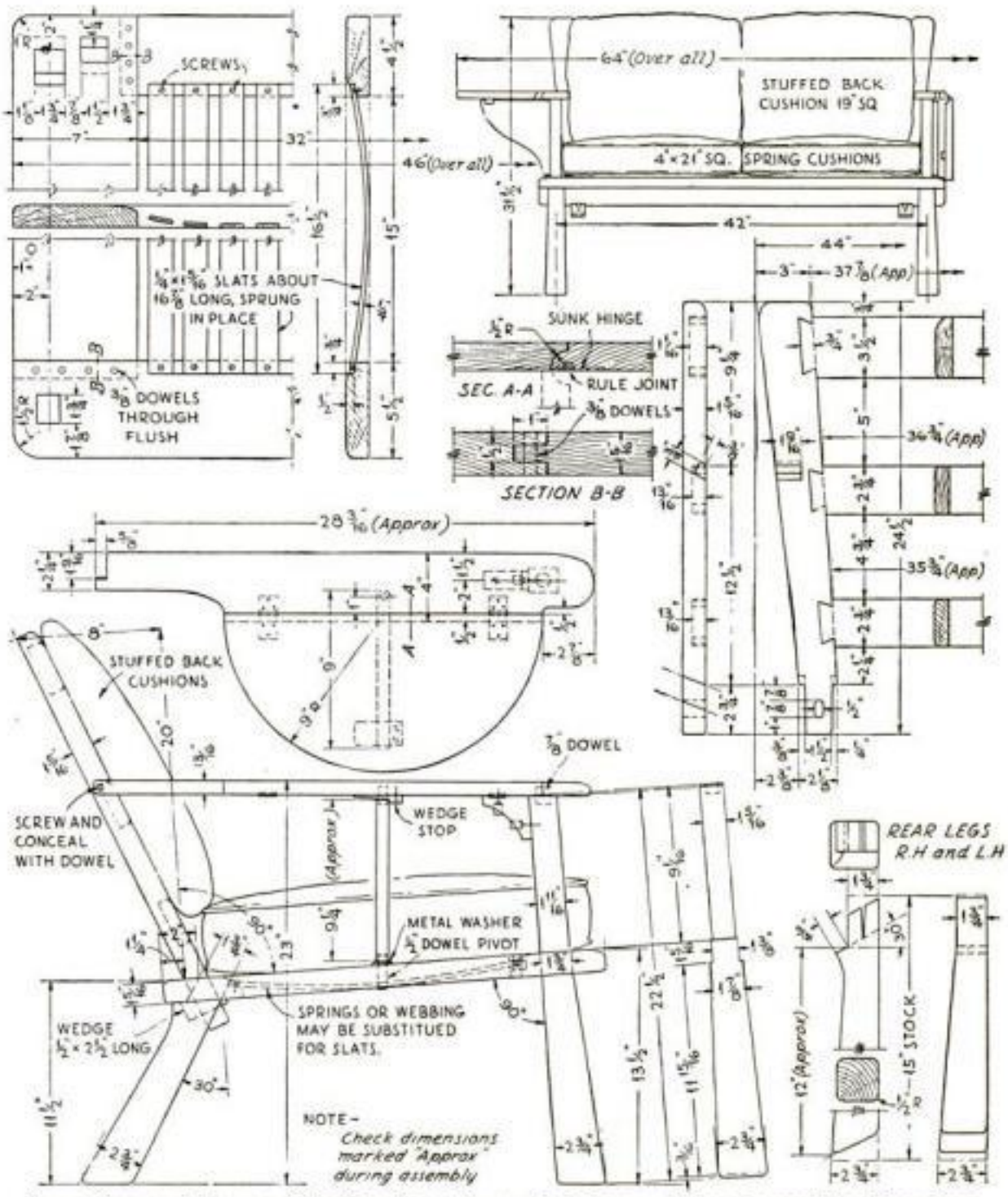
Rear view showing the butterfly support for the drop leaf or extension arm. The slats that hold the seat cushions are also visible. *At left:* How the frame is blocked up so the legs can be scribed for cutting off

THE "eye appeal" of this Early American maple love seat depends on its outline, structural details, and finish. Its comfort is due to the modern inner-spring seat cushions and stuffed back cushions and the correct proportion of the seat and back angles. The straight lines and squareness of its design are softened by rounding off all sharp corners and edges.

Its construction does not demand exceptional skill nor extensive tool equipment; the prime requisite is care—care in selecting well-seasoned maple of uniform light color, care in making all joints accurately, care in planing, scraping and sanding the surface, and care and patience in finishing.

The following order of procedure is suggested. The dimensions marked "approximate" on the drawings should be checked during assembly, as they may vary because of slight differences in fitting the leg and back joints in the seat.

1. Cut and fit the seat frame.
2. Cut holes for legs and back post in the seat-frame members before assembling, as they may be more easily handled separately. This may be done by hand chisel or on drill press with router bit. If on the latter, the corners of rear holes may be left round, and the fitting parts rounded to fit.
3. Glue seat, peg the joints, and surface with plane and scraper.
4. Cut out legs; shape with file, plane, and scraper, and fit accurately to holes in seat.
5. With legs fitted in place, block up seat on a level bench so that the top front edge is elevated 15½ in. and rear top edge 13½ in., as shown in one of the illustrations. Scribe a line 2 in. from the bench top around each leg. A surface gauge is handy for this purpose. Remove legs and cut them off on the scribed line. Later cut off upper end *(Continued on page 81)*

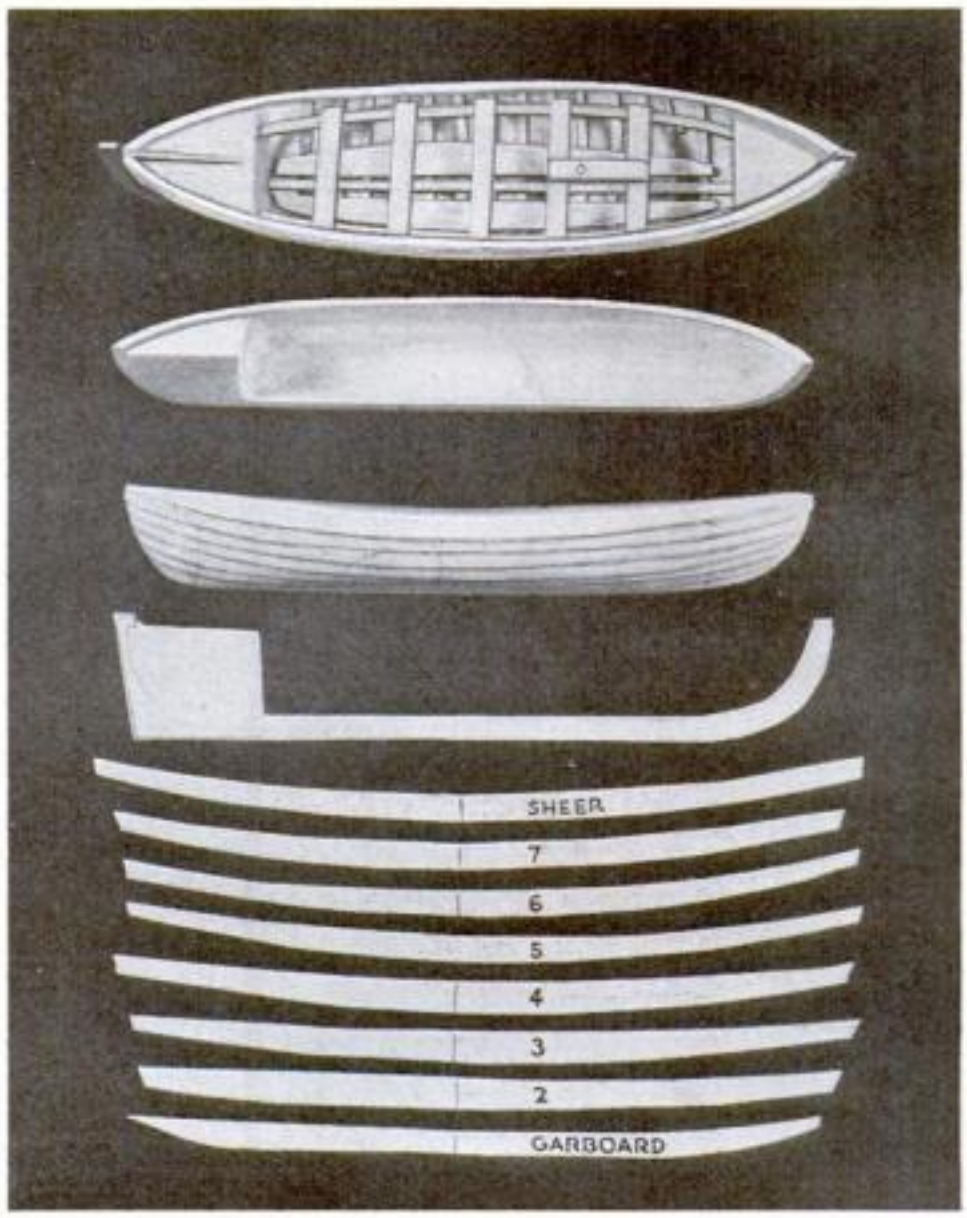


Front view, end view, and details of seat frame, back, legs, and drop leaves. The dimensions are suitable for standard 21-in. square seat cushions, but may be modified to take other sizes

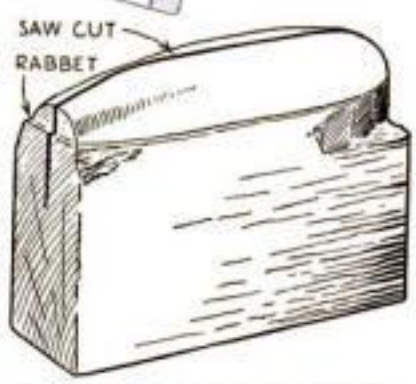
Organize a home workshop club. Send stamped envelope for information.

MY METHODS OF BUILDING Realistic Small

Model of whaleboat 3¼ in. long and 15/16 in. in beam. The halves are carved from wood, and planks are represented by gluing on thin cardboard strips as indicated. Between the two halves of the boat is glued a backbone cut from fiber as indicated



By Capt. E. Armitage McCann



Mold or form used for making a boat from thin cardboard by first method given in the text

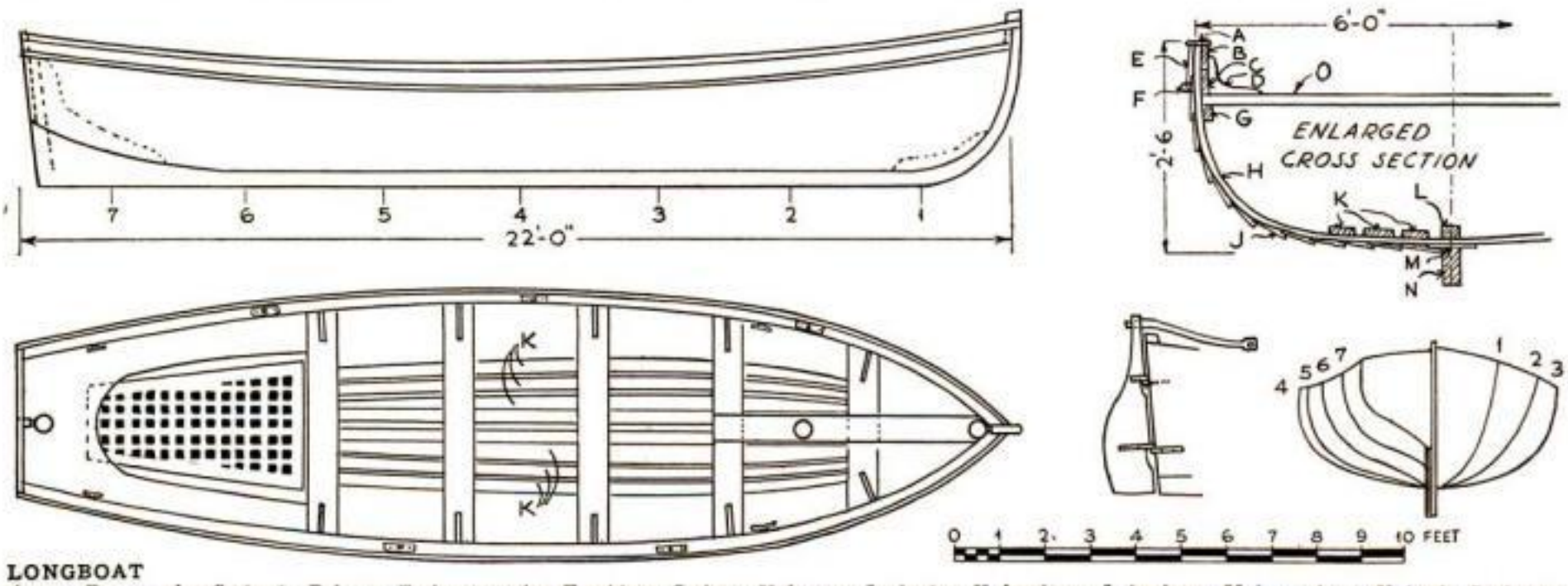
WELL-MADE small boats add such a pleasing and interesting finishing touch to a ship model that it is a pity more trouble is not taken to make them correctly. One so often sees an otherwise fine model with impossibly shaped or carelessly made boats.

The methods to be described will work well from, say, a 1/16-in. to a 3/16-in. scale; smaller boats will need less, and larger will need more, detail than shown.

The previously published plans for making the U.S.S. *Hartford* (P.S.M., Jan.-May, '34) gave the lines of three boats suitable for a ship of her style and period and are the examples I have developed for this article. They would be sufficiently correct for similar vessels from the middle of the eighteenth century to the present day. Navies had, and have, of course, many other shapes and sizes; the American Navy at present lists six types of power boats and nine sailing and pulling boats, varying from a 50-ft. steamer to a 12-ft. wherry.

For merchant vessels the question of boats is easier. For well over a hundred years they have carried, almost exclusively, double-ended lifeboats, longboats or work boats, and gigs or dinghies. Accurate lines are given for the first two of these from which, by altering the scale, any clipper ship's boats can be made.

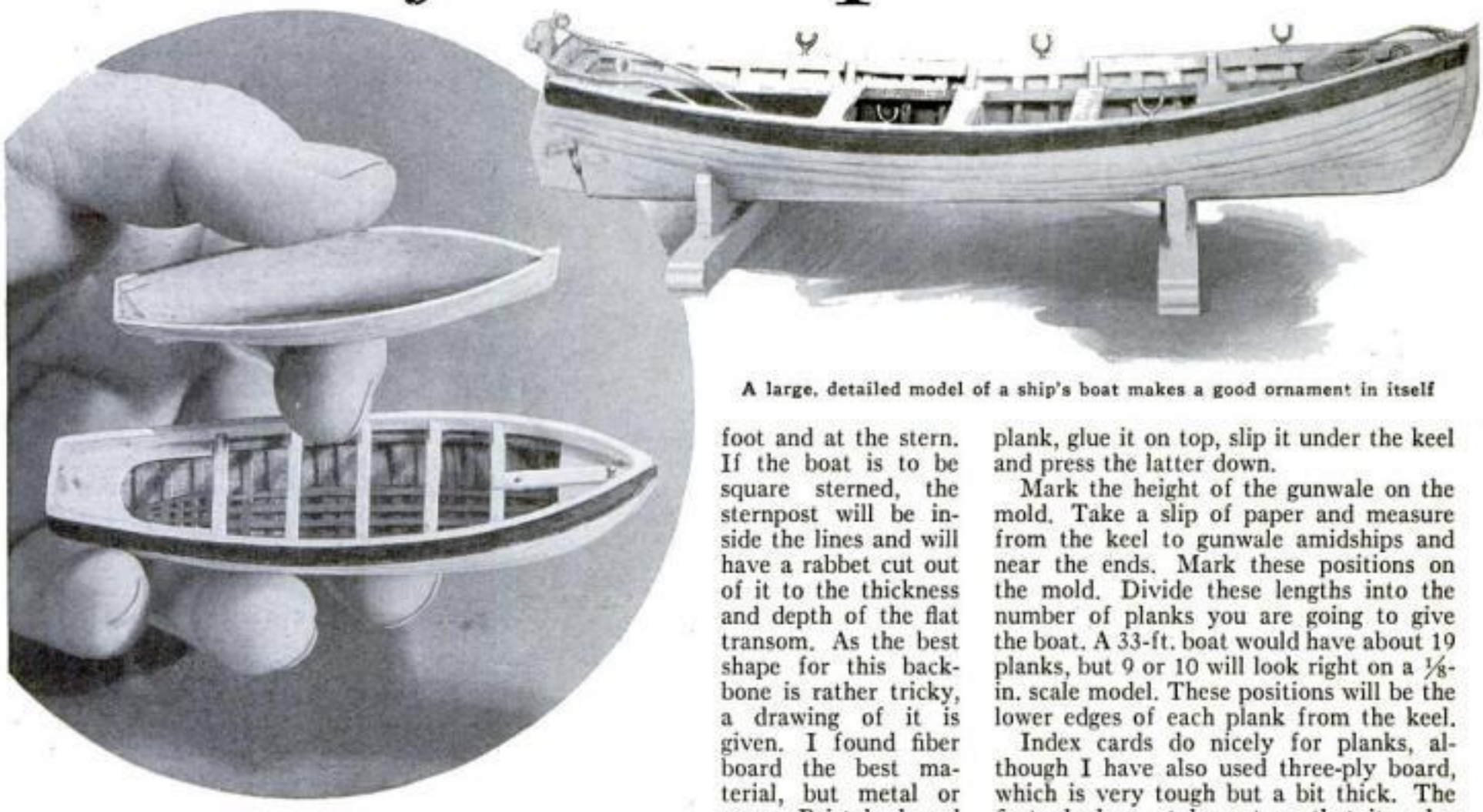
On the various POPULAR SCIENCE MONTHLY ship-model blueprints will be



LONGBOAT

A **cap,** ***B*** **gunwale,** ***C*** **chock,** ***D*** **knee,** ***E*** **sheer strake,** ***F*** **rubber,** ***G*** **riser,** ***H*** **frame,** ***J*** **planks,** ***K*** **footings,** ***L*** **keelson,** ***M*** **hog piece,** ***N*** **keel,** ***O*** **thwart**

Boats *for* Ship Models



A large, detailed model of a ship's boat makes a good ornament in itself

The 24-ft. cutter and 33-ft. launch of the *Hartford*. The first is made of wood in two halves; the second of overlapped cardboard "planks"

found the lines of boats suitable for their respective ships.

I have found that the method which gives the best boat is little, if any, harder than supposedly simpler ways of making a boat not quite so good. I shall therefore describe how I made the 33-ft. launch and other boats like it for the *Hartford*.

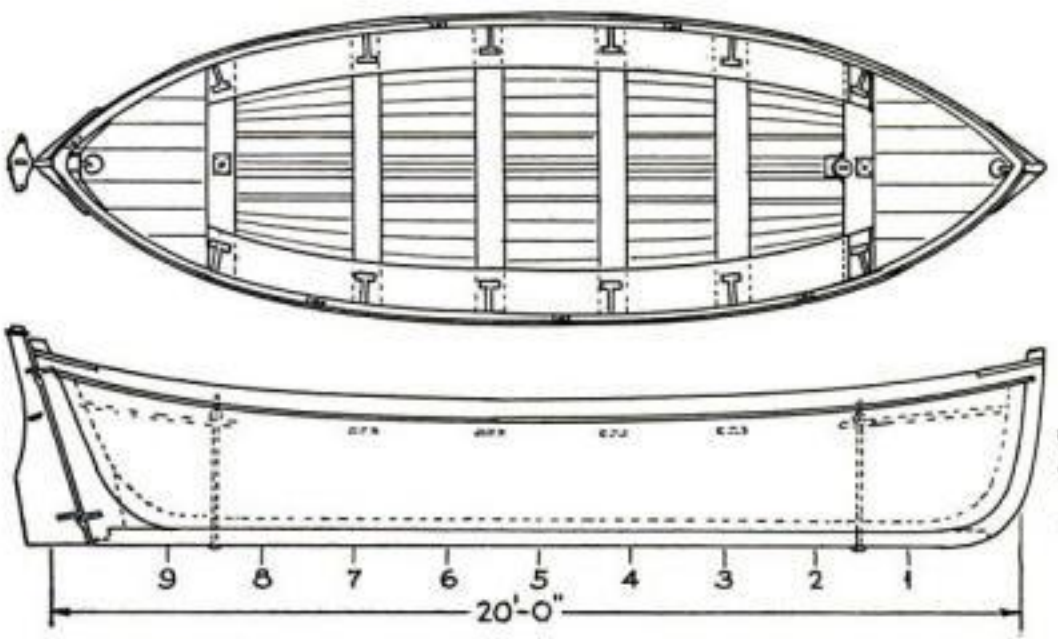
Take a piece of white pine the length and breadth of the required boat and about 3 in. deep. Whittle the top of this to the shape of the boat, but let it be enough smaller to allow of a double thickness of "planks." This is the mol or form. Set it in the vise and make a small saw cut at both ends. From the plan, cut a stem, sternpost, keel and deadwood (if any) in one piece. The thickness should be about 1/32 in., and the depth, to start with, about ⅛ in., with a little extra at the fore-foot and at the stern. If the boat is to be square sterned, the sternpost will be inside the lines and will have a rabbet cut out of it to the thickness and depth of the flat transom. As the best shape for this backbone is rather tricky, a drawing of it is given. I found fiber board the best material, but metal or even Bristol board would do. If metal is used, have the center part of the keel only the depth of the keel. The extra allowance in the other material is merely to give it strength while building and is to be cut off the finished boat before it is removed from the mold.

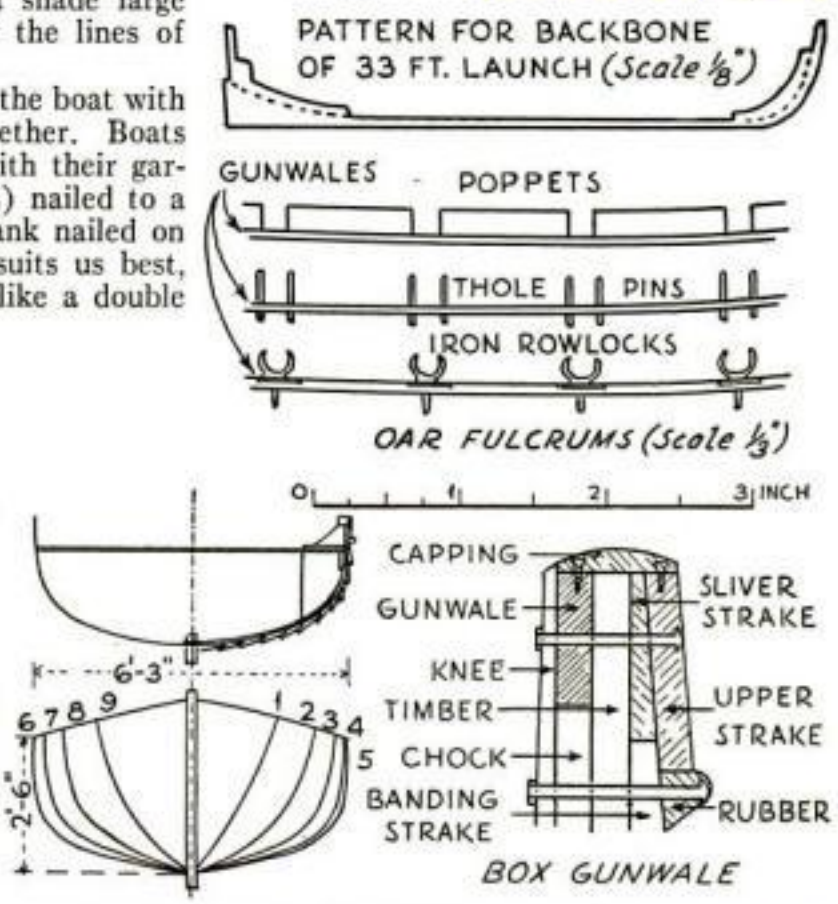
Thoroughly wax the mold to prevent glue from sticking. Set the stem and stern in the slots—an easy but not wabbly fit. Nail a thin wooden transom across the stern of the mold to fit in the rabbet made in the sternpost; make it a shade large and file the edges to follow the lines of the sides of the mold.

Now we are going to form the boat with cardboard planks glued together. Boats are most frequently made with their garboard strakes (lowest planks) nailed to a hog piece, which is a flat plank nailed on the keel, inside. This plan suits us best, so we make a curved piece like a double plank, glue it on top, slip it under the keel and press the latter down.

Mark the height of the gunwale on the mold. Take a slip of paper and measure from the keel to gunwale amidships and near the ends. Mark these positions on the mold. Divide these lengths into the number of planks you are going to give the boat. A 33-ft. boat would have about 19 planks, but 9 or 10 will look right on a ⅛-in. scale model. These positions will be the lower edges of each plank from the keel.

Index cards do nicely for planks, although I have also used three-ply board, which is very tough but a bit thick. The first plank must be cut so that its edge lies along the keel and runs up onto the stem and stern. Its shape, and those of the other planks, will be more or less as shown for the whaleboat. Each plank must lie quite flat on the mold and be cut, not twisted, to lie in place. I cut the planks about twice the width that will show amidships and about one and a half times the width at the ends, so as to have something to glue to. Glue this first plank to the hog piece and the keel, but not to the mold. With your paper scale mark where the lower edge of the *(Continued on page 92)*



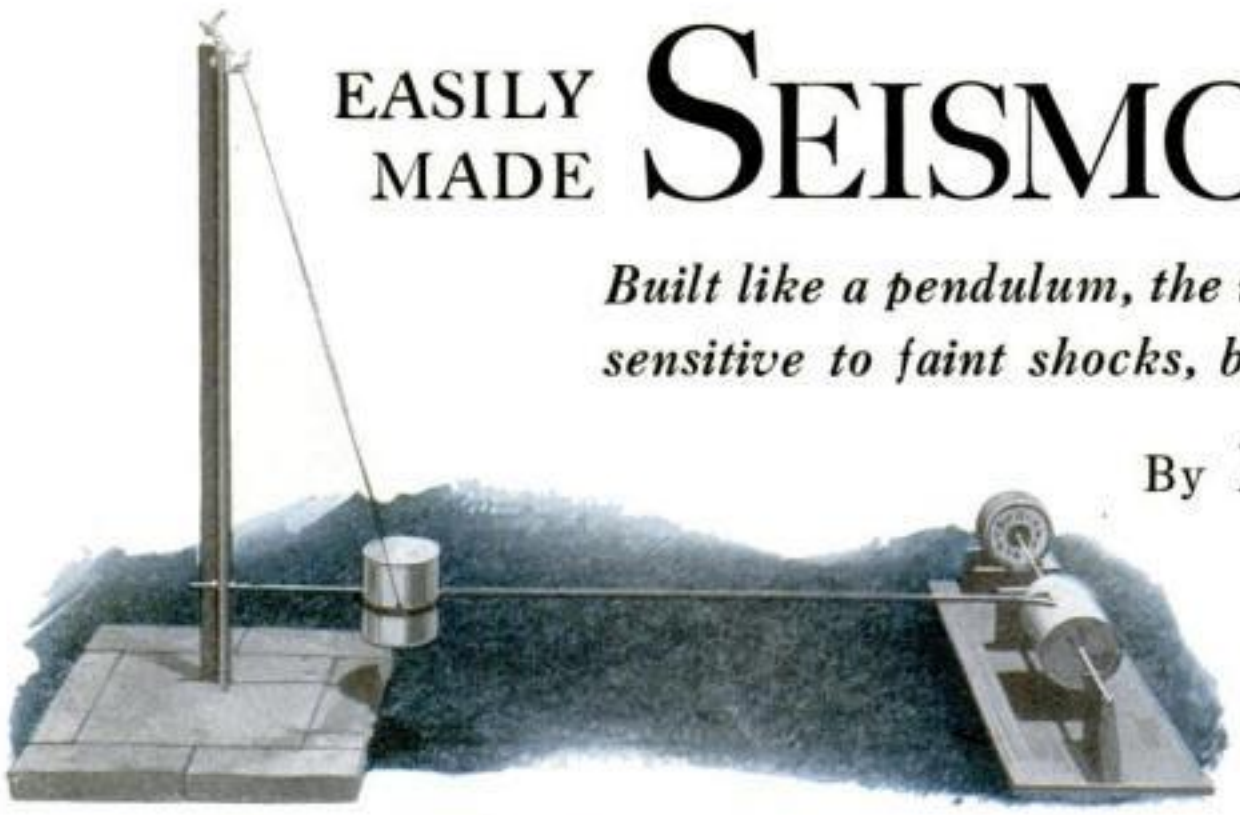


Lifeboat with position of buoyancy tanks dotted in; backbone of the model of the *Hartford's* launch; oar fulcrums, and box gunwale

EASILY MADE SEISMOGRAPH

Built like a pendulum, the instrument is amazingly sensitive to faint shocks, but not to nearby traffic

By ROY H. BALDRIDGE



Complete seismograph and recorder. Earthquakes from 200 to 6,100 miles away have been registered

THIS very instant the ground trembles beneath your feet. The earth's crust, seemingly, is never at rest; and somewhere in the world, perhaps in the center of a continent, possibly beneath some ocean, a quake is in action that may send its vibrations around the globe. For sheer unbelievable, horror-tinged experience, with the terror of a nightmare imposed on reality, there is nothing quite like a stiff earth shock. To the accompaniment of low-pitched rumbling, the ground writhes, trees sway, and buildings crash, while the sickening realization comes that there is no rigid thing left to which you can cling for support.

No one knows when or where an earthquake will occur. For this reason scientists are studying earth movements, and have learned much of the nature of such disturbances, as well as what can be done to lessen damage from them.

By building a seismograph similar to the one illustrated, you can make a hobby of quake recording yourself. You may have to wait only a few hours after completing it to check up on a shock, and at most only a few days will elapse. My seismograph has recorded forty-three earthquakes within six months, varying in distance from 200 to 6,100 miles. Although it is located within 75 ft. of heavy street traffic, no bad effects are noticeable.

This instrument consists of a horizontal pendulum suspended by a fine wire from an upright post in a heavy foundation. When the earth trembles, the bob, freely suspended, remains almost still while the post and pivot vibrate. A delicate point at the end of a long, light arm fixed to the bob magnifies the movement of the ground and scratches the record of it on a smoked paper wrapped around a revolving drum.

The post is an angle iron drilled as detailed in the drawing. Set it up in a concrete foundation about 16 in. square and 9 in. high; or a shell of bricks may be built up, and concrete poured in the center. While this hardens, make the other parts.

The bob, or weight, is of lead, melted and poured into a can about 3 by 3½ in. The dimensions may vary somewhat. If the can is packed in damp sand, the hot metal will not run out when the seams open.

In the center of the side of the weight, drill and tap a ¼-in. hole, ¾ in. deep. Thread a ¼-in. brass rod 5 in. long at one end to screw into the bob, and if it is too loose, make a few dents in the lead. Cut off the end of the rod so that the distance to the center of the weight is 5¾ in., and drill a hole in the end slightly larger than an extra-loud phonograph needle, of such depth that the inserted needle will be exactly 6 in. from the point to the bob center. A little solder melted into the hole around the needle will fasten it.

In the center of each side of the weight, at right angles to the rod, drive a small finishing nail, allowing the head to project about ¼ in. Attach a stirrup of No. 14- or 16-gauge iron wire to these nails with loops, and tie the suspension wire to the center, thus bringing the point of suspension to the center of the bob.

Three adjustment points are provided in the seismograph. The upper, or wire adjustment (*A* in the diagram) consists of a threaded brass rod bent L-shaped and pierced with a small hole. It is screwed into a bracket consisting of a brass plate with the upper end bent back at a little more than 45 deg. A lock nut behind the bracket keeps the adjustment rod from changing position.

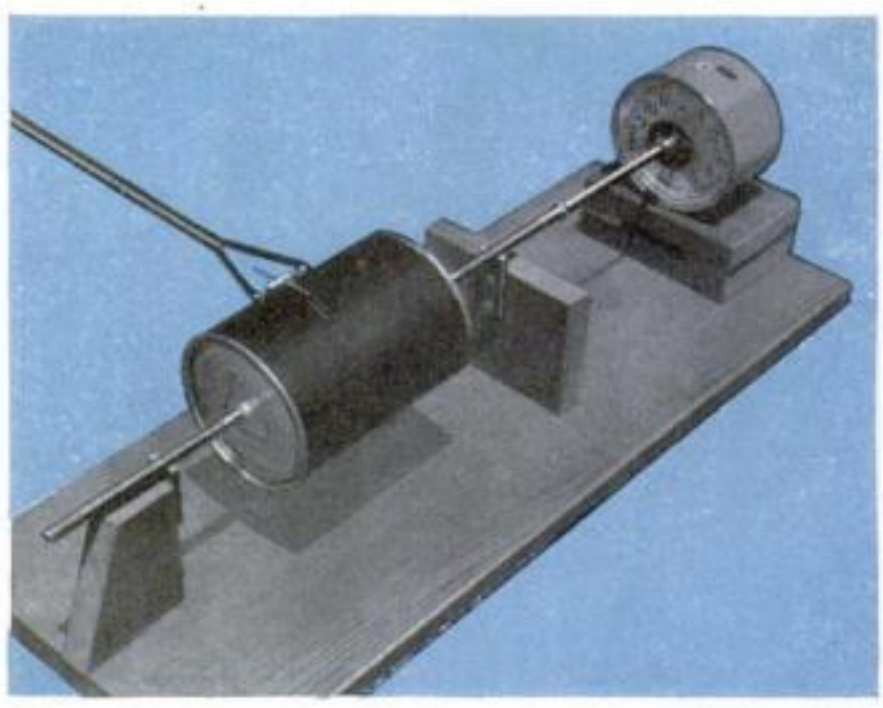
Adjustment B, for shifting the upper support sidewise, is a piece of ⅛ by ¾-in. brass bent U-shaped, with a 3/16-in. threaded brass rod running through the ends. The U is not threaded, serving merely as a bearing for the rod, which is kept from end motion by two nuts that are soldered to the rod after being tightened against the U. The U, together with the bracket for *A* adjustment, is fastened to the post with a ¼ by 1-in. machine bolt.

Adjustment *C* is made of ⅜-in. brass rod threaded full length, with a slot cut in the rear end for a screw driver. To the other end solder a cone cup bearing from an old clock balance wheel, as a pivot for the phonograph needle in the bob rod. Supply the adjusting screw with a nut before and behind, after inserting it in the lower hole of the upright, and tighten it with the cup bearing about ½ in. from the surface of the post.

Make the extension arm of 30-gauge aluminum, forming it into a tapered channel by folding up the sides as indicated. The small end terminates in a Y formed by cutting out the bottom and spreading the sides to accommodate the stylus assembly.

For attaching the arm to the weight, make a sheet-brass clamp ½ in. wide and 10 in. long to bind around the bob, where it is held with a screw and nut in the bent-out lugs, as shown. A strip of brass ½ by 4½ in., with ½ in. at one end bent at right angles, is soldered to the clamp and fastened to the extension arm with two small bolts.

To assemble the machine, thread the suspension wire (a fine music wire, such as a guitar E-string) through the hole in adjustment rod *A*, and rest it between threads on adjustment *B*. Turn *A* until the pendulum, with the needle tip in the bearing of *C*, is horizontal from the bearing to the bob center. The weight should



The stylus rests on a drum made from a can and covered with smoked paper. A threaded shaft draws the drum endwise as the clock turns it

Records Distant Earthquakes

come to rest with its rod at right angles to the face of the angle iron, the necessary adjustment being made by turning the rod of *B*.

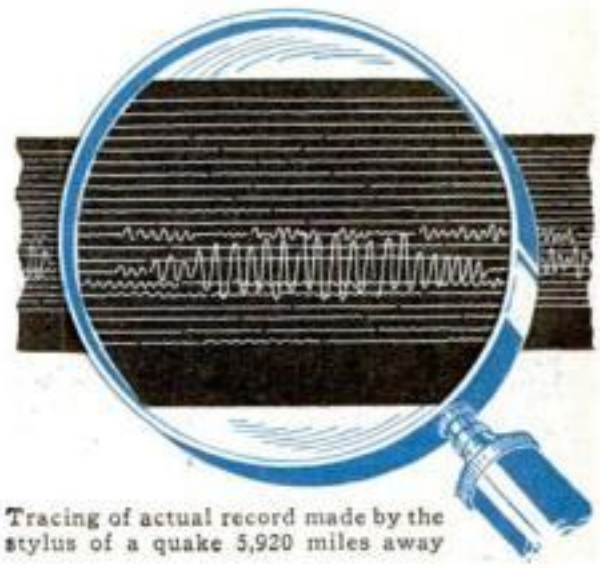
You now have a horizontal pendulum with a definite period of oscillation. The period is the time in seconds required for the weight to make a swing back and forth. With the pendulum in motion, and using the farthest movement to the right as a starting point, check the time in seconds required for the weight to move to the left and back to the starting point again.

After your first adjustment, the period will probably be six or eight seconds. To change it, shift the pivot outward, nearer a point directly below the upper support, by loosening the nut on the rod behind the angle iron and tightening the front one. Continue moving the pivot outward until the pendulum has a period of twelve seconds.

If the seismograph is placed out of doors it should be in a dry, shady spot, and a larger foundation should be used, or water seepage under the foundation will cause the needle to wander off the paper. Place a screen around the instrument to prevent the wind from blowing directly on the pendulum, which is very sensitive to air currents around it. If the currents are very troublesome, the seismograph should be entirely inclosed.

The recording drum is simplicity itself. Obtain a tin can of about the size indicated and mount it on a ⅜-in. brass tube for a shaft. One end of it is threaded, while the other is left smooth and terminated by a washer having a square hole in it slightly more than ⅛ in. on a side.

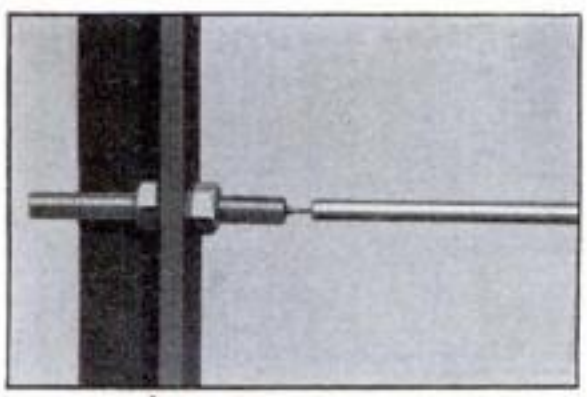
Bearings are made by drilling bar brass to receive the shaft and mounting screws. Drill one 7/16 in. in diameter and thread it to fit the shaft threads, but drill the other ⅜ in. for a plain bearing. Having cut off the ends, screw the plates to wooden mounting *(Continued on page 96)*

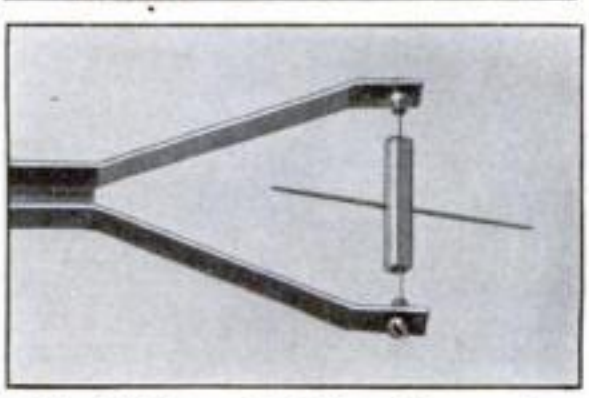


Tracing of actual record made by the stylus of a quake 5,920 miles away

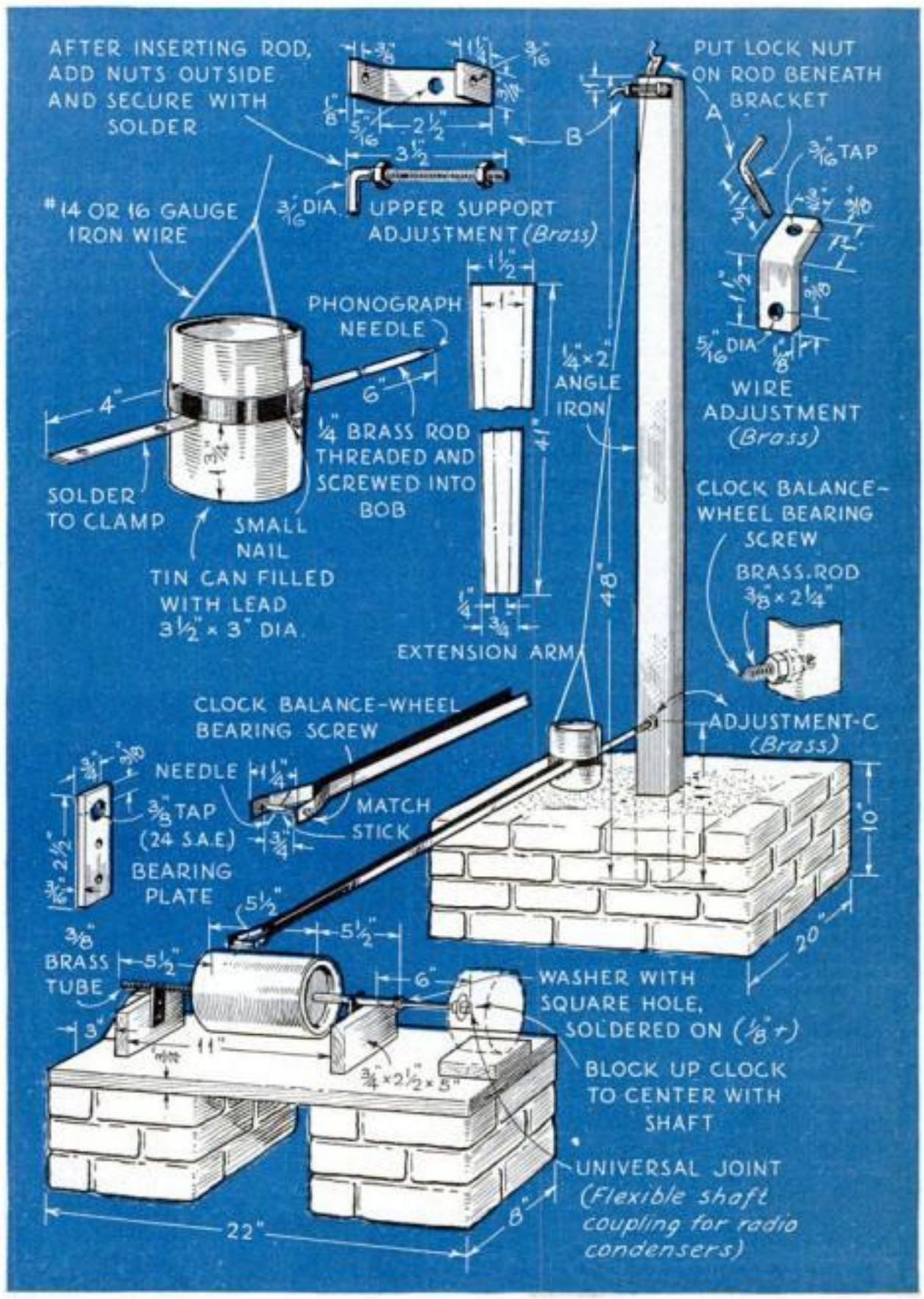
Close-up of top of post showing method of adjusting the wire accurately in respect to length and position. These parts are marked *A* and *B* in the drawing

Below is the pivot and the adjustment that is marked *C* in drawings. A cone cup bearing from an old clock balance wheel and a phonograph needle form the pivot





A detail photograph of the stylus mounting. Note that the needle is counterbalanced so as to exert very little pressure on the drum

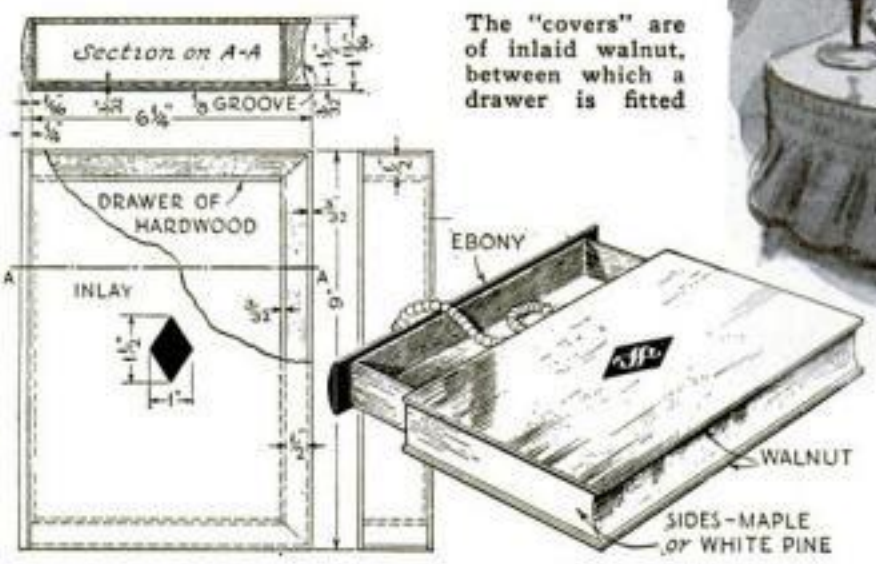


How the seismograph is set up and details of the more important parts. The dimensions are those of the original instrument constructed by Mr. Baldridge and thoroughly tested over a long period

GIFT JEWEL BOX OF WOOD LOOKS LIKE BEAUTIFULLY BOUND BOOK

DESIGNED to resemble a book, the jewel box illustrated is an unusually attractive project for a Christmas gift. It requires very little stock and there is nothing difficult about the construction.

The box or cover is made of three sidepieces of maple or white pine with mitered joints, and a top and bottom of 3/32-in. walnut. The long sidepiece is grooved about ⅛ in. deep as indicated. This can be done by hand with a gouge, or the groove may be cored out with a circular saw. The top and bottom pieces may be inlaid with a small lozenge of holly or other light wood as shown, or with a more elaborate inlay, if preferred. The other part is merely a drawer of hardwood made in the form of a box to slide into the cover. To the front of the drawer is glued a piece of ebony or other dark wood shaped like the slightly rounded back of a book.



The "covers" are of inlaid walnut, between which a drawer is fitted

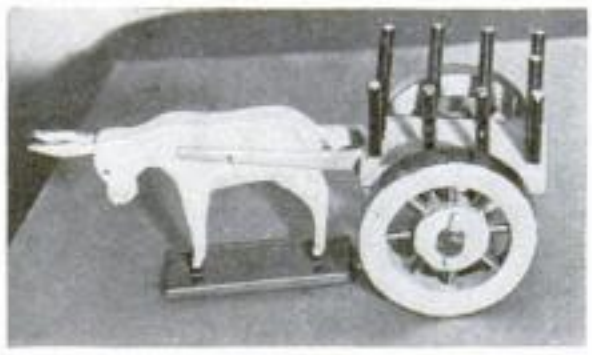
Apply a light wood filler to the walnut; then give the entire box a rubbed varnish finish.—FRANK SCHNEIDER.

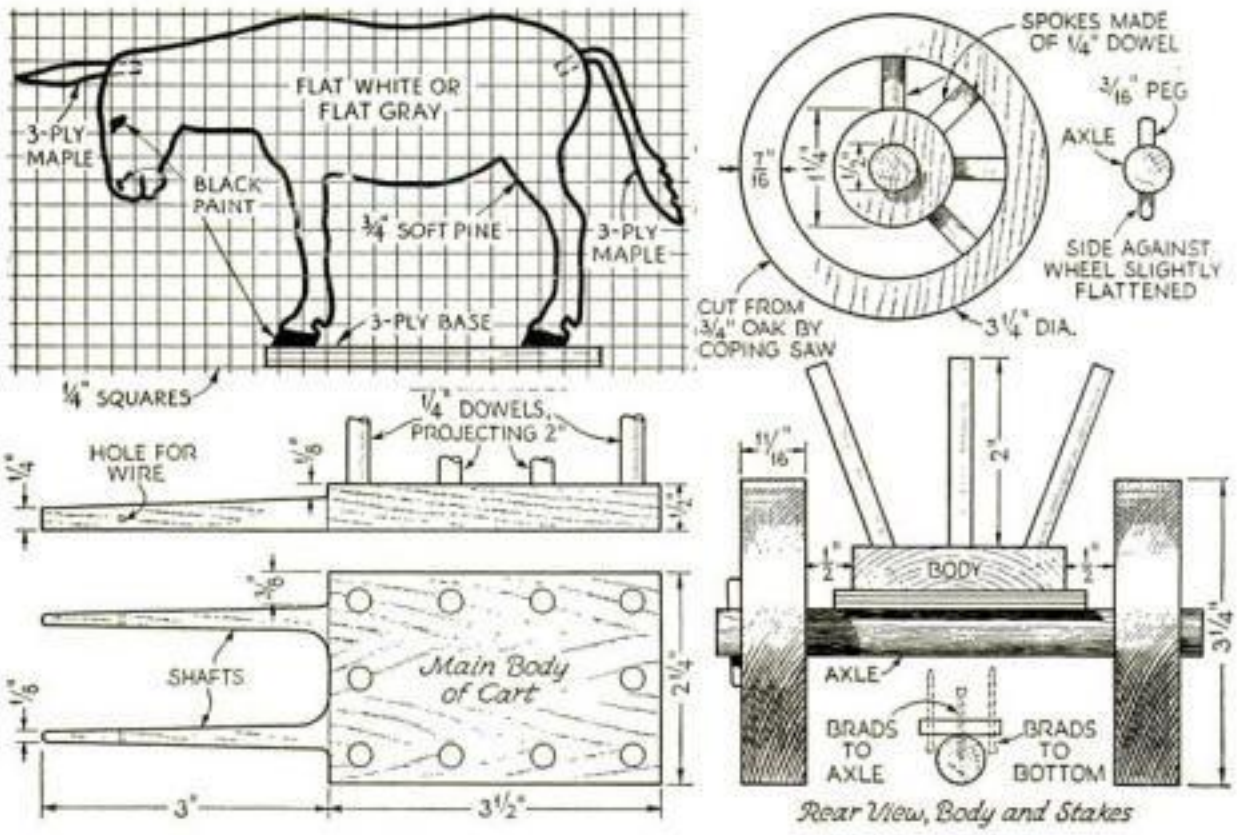
Plans for Toy Donkey and Cart That Won a National Prize

THIS toy donkey with its colorful cart has an amusing and quaintly decorative quality that wins approval wherever displayed. Rufus C. Dawes, Lorado Taft, and the other judges of the First National Homeworkshop Guild Exhibition in Chicago last March liked it so well that they selected it from a number of much more elaborate projects for third prize in the novelty and toy division. It was made by P. F. Hirsch, secretary of the Newcastle (Calif.) Homeworkshop Club.

The wheels for the original model were cut out with a coping saw by hand from ¾-in. oak, not too regularly. The spokes, which are ¼-in. birch or maple dowels, should be spaced a trifle unevenly. The hub is bored, and the circumference sawed slightly irregular. A ½-in. dowel is used for the axle, and holes are drilled near each end for 3/16-in. hardwood pegs, which hold the wheel on. The side of each peg next to the wheel is flattened a little.

The main body of the cart and the shafts are cut from a single piece of wood ½ by 2¼ by 6½ in. The stakes are ¼ by 2½-in. dowels, those at the sides being set at an angle as shown. The cart axle is slightly flattened and nailed to a piece of three-ply maple sufficiently wider than the axle to allow room for driving brads through it into the bottom of the cart.



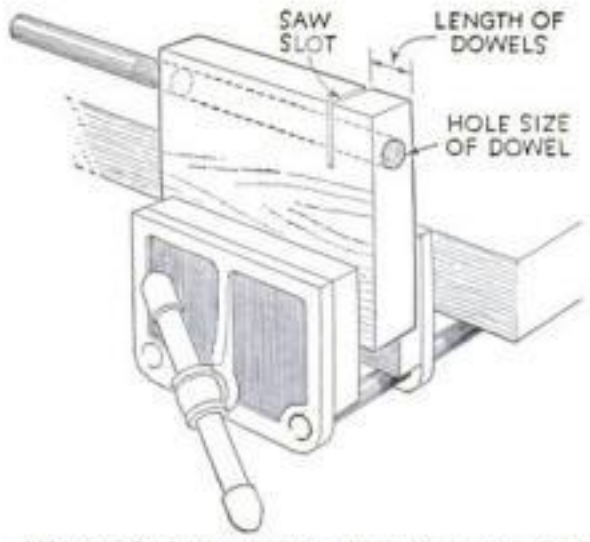


How the cart is constructed and a pattern for the donkey, laid out on squares for easy enlargement

The donkey is sawed from ¾-in. soft pine and fastened to a three-ply base, ¼ by 1½ by 3½ in. The ears and tail are cut from three-ply maple and inserted in holes as shown. The tail is set at such an angle that it will not strike the bottom of the cart. A wire is passed through the holes in shaft and donkey and bent over at each side so it will not slip out.

The cart body, wheel felloes, and hubs are painted medium green; the axle, spokes, and stakes, bright red; and the donkey gray or flat white with black hoofs. A few brown brush marks are added on the sides of the tail at the end and also on top of the ears. A drop of black or brown paint serves for the eyes and nostrils.

JIG FOR SAWING DOWELS INTO SHORT LENGTHS



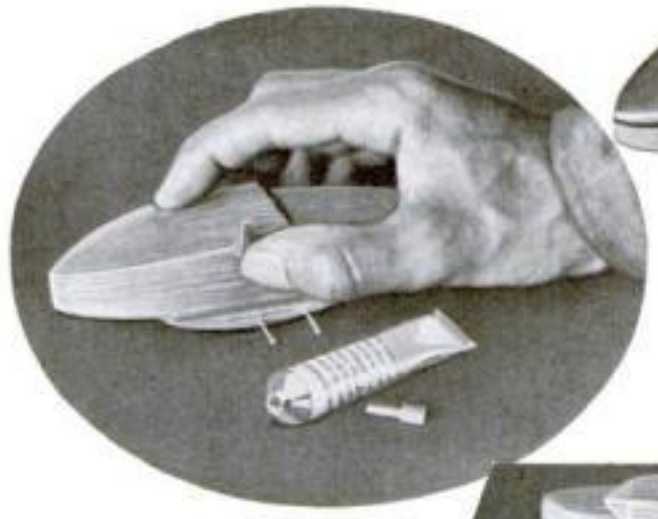
WHEN it is necessary to cut a number of short dowel rods to a certain length and the ends must be smooth, a jig or gauge can quickly be made as shown above. After one piece has been cut, push it out and be sure that the uncut portion of the dowel rod is flush with the edge before cutting the next piece. The jig may be held in a vise, or if a band saw is available, simply lay the device on the table and saw each time in same slot.—W. B.

DONALD W. CLARK designs a solid model of a

New Flying Boat

THE ARGONAUT PIRATE

Model of a modern pusher-type amphibian. It has a wing spread of 13⅛ in. and is 9¼ in. in length over all. *At left:* Holding a wheel strut in place until the glue has time to set

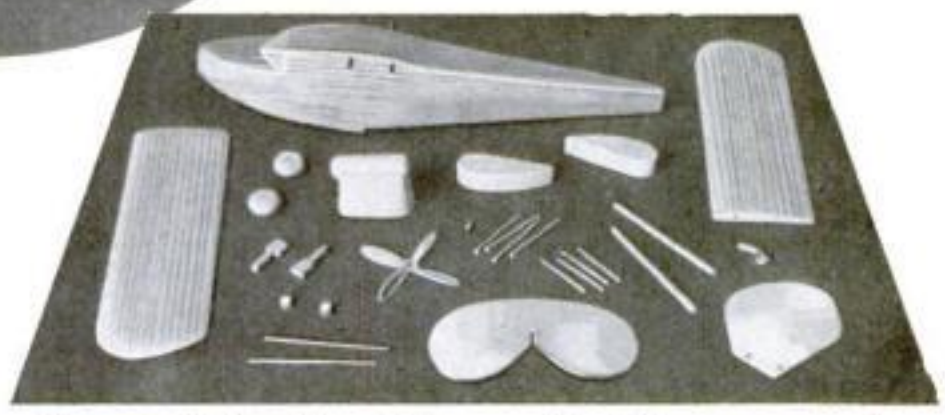


ONE of the neatest planes among the smaller amphibian designs is the new three-place, high-wing, pusher-type flying boat known as the Argonaut Pirate. The span is 35 ft. 4 in., and the length 26 ft. It is powered with a Menasco Pirate C-4 engine, which develops 125 horsepower. This is said to give the boat a service ceiling of 15,000 ft. and a climbing rate of 1,000 ft. per minute. The cruising range is specified as 500 miles.

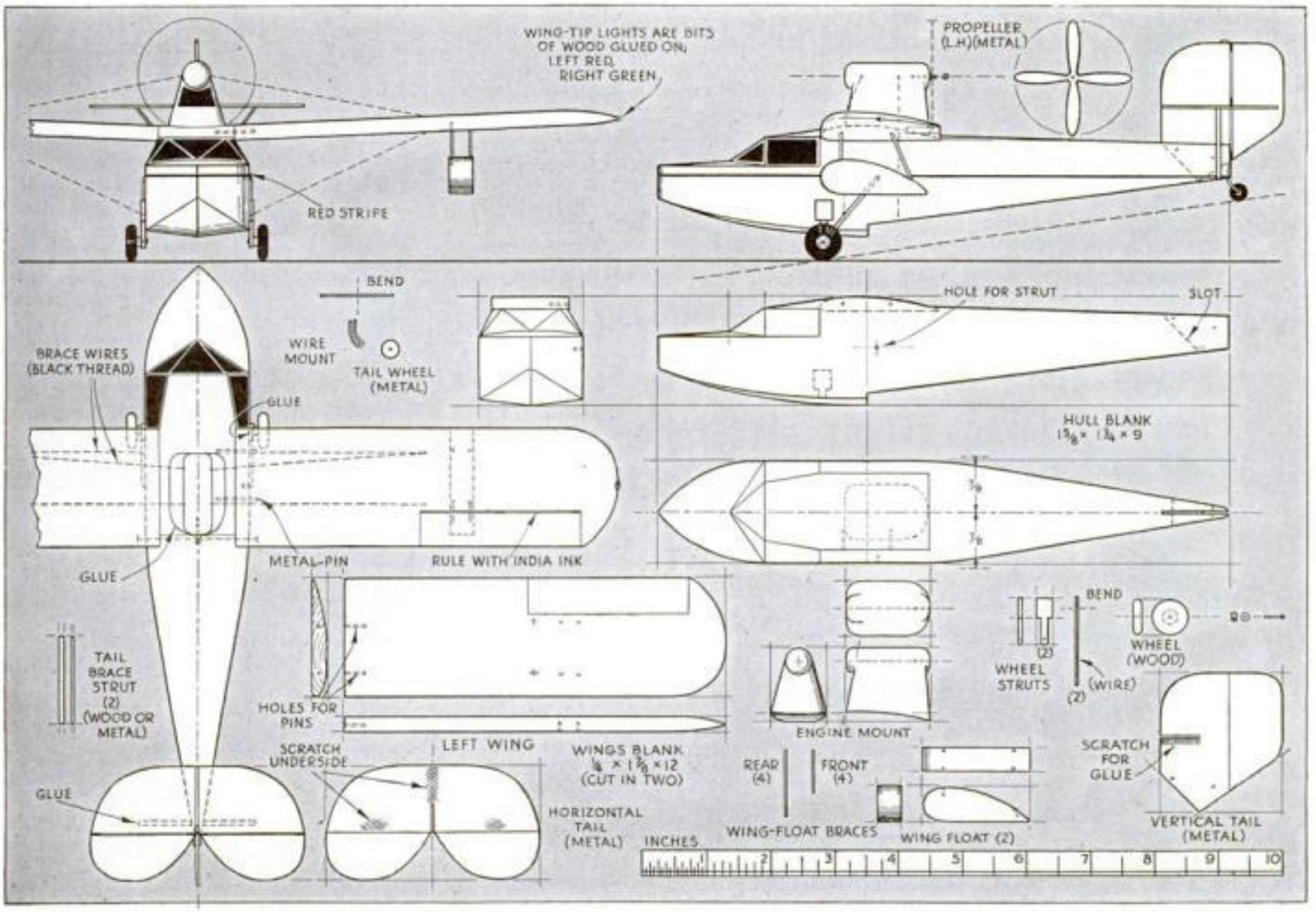
The scale of the model in relation to the real amphibian is ⅜ in. equals 1 ft. Not counting the wire struts, there are only seventeen parts to this model. If the struts are included, it brings the number of pieces up to twenty-nine.

Like all the planes given in this series, the Argonaut Pirate is so simplified in constructional design that readers will have little trouble in making and assembling it, provided, of course, that they follow the drawings closely and refer to the photographs. The number of parts required is reduced to the lowest possible figure, and the true design of this flying boat could not be duplicated in a model with any less than the twenty-nine parts indicated.

The suggested color scheme is silver, red, and black. Paint the entire model aluminum, put a red stripe along the sides of the hull, as shown, and make the windows, tail wheel, and hinge lines black. Dipping the wheels in ink will give the tires a realistic appearance.



The parts of the model ready for assembling. There are twenty-nine pieces altogether, but a dozen of these are simple struts and braces



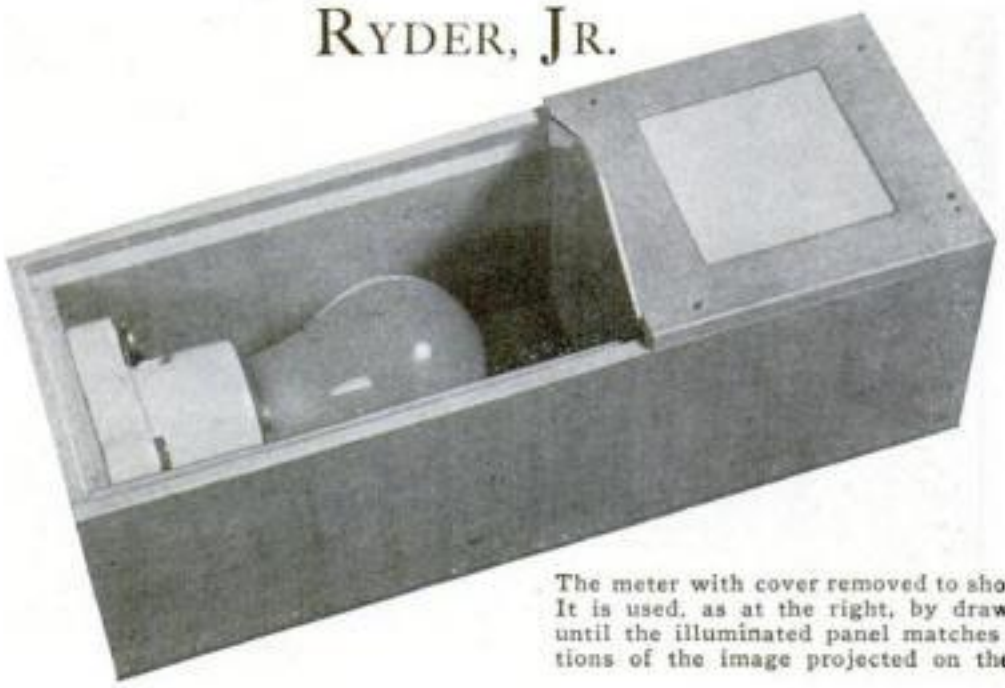
Front, side, and top views; details of the hull, engine mount, tail members, wing floats, and other parts; and a scale for finding dimensions

Send stamped envelope for information on starting a home workshop club.

HOMEMADE
Light Meter

Takes Guesswork out of Enlarging and Printing

By FREDERICK D. RYDER, JR.



The meter with cover removed to show lamp and slide. It is used, as at the right, by drawing up the slide until the illuminated panel matches the lightest portions of the image projected on the enlarging easel

IF THE amateur photographer who does his own developing, printing, and enlarging could only hit exactly the right exposure every time he takes a picture, the job of printing and enlarging would at once become far simpler and less wasteful.

Unfortunately, however, even the expert cannot make uniformly perfect negatives under varying conditions of light; and the average amateur, especially the beginner, spoils sheet after sheet of paper trying to find the right printing time for negatives of every conceivable density.

In enlarging it is, of course, quite practical to save a lot of the paper ordinarily wasted by cutting large sheets into narrow strips that can be used for testing. Another useful scheme is to sort your negatives into piles according to density before you start work. Then by carefully comparing the negative you have just printed or enlarged with the one you will do next, you can get some idea of what the correct exposure should be. Such a test can best be made by holding the two negatives side by side in front of a brightly lighted piece of white paper.

The chief difficulty with such a test is that it can only be approximate at best, because when the negatives are not of exactly the same density, it becomes a matter of guesswork as to just how much difference in printing time will equal the apparent difference in the light-transmitting power of the two negatives.

What is needed is a way to measure with some degree of accuracy the actual density of each negative. The simple, easily made light meter illustrated on this page supplies that need. You will be amazed at the accuracy with which it will give you the correct exposure for any scale of enlargement from any negative, no matter how thin or dense it may be.

The principle on which this meter operates is very old. In fact, the earliest accurate determination of the candle power of various sources of light as compared with a standard candle was made by a piece of apparatus working on almost exactly the same principle.

The basic idea is to adjust a variable source of light to match the unknown source and then read off the strength of the unknown source by the calibration of the variable known source.

The accuracy of the system depends on the fact that the human eye will determine very closely when two surfaces are illuminated to the same intensity (if they are of the same color), although the eye is not at all accurate in estimating the difference in brightness when one surface is more brightly lighted than the other.

To use the homemade exposure meter, all you do is place it beside the enlarging easel and draw up the slide till the lighted panel in the meter is of the same brightness as the lightest portions of the image thrown on the enlarging easel by the lens. Then you read off the correct exposure from the figures on the side of the slide. You will find that the resulting enlargement is correctly timed within surprisingly close limits.

It is obvious that the general principle of a uniformly lighted surface with varying light control *(Continued on page 78)*

How the meter is constructed. Note the curved reflector visible through the square opening

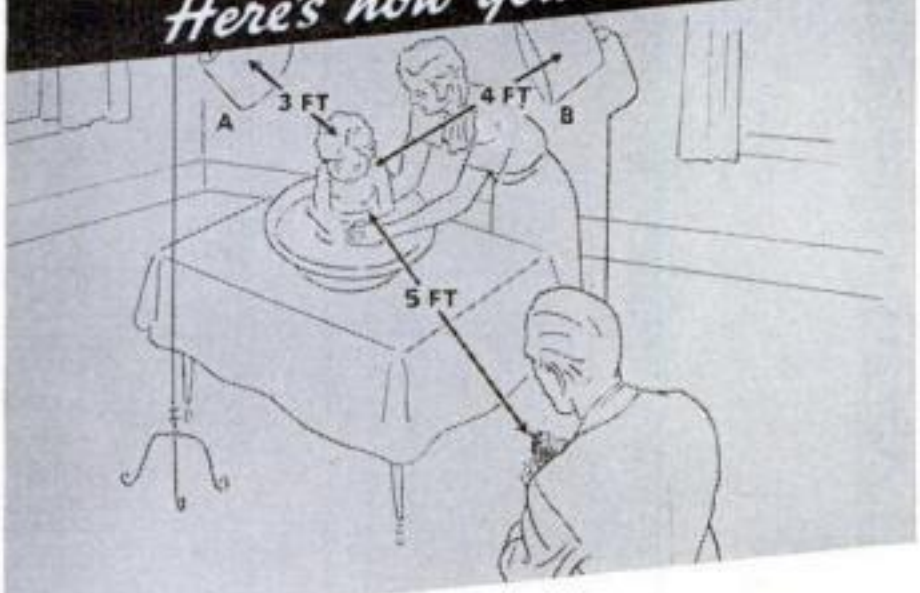
Make a picture like this *Tonight!*

HALF of life is lived indoors . . . And what an important half it is. Now the new ultra-fast Kodak "SS" Film helps you make the most of it. You can make snapshots *indoors, at night.*

Very simple, too. In addition to the new Kodak Super Sensitive Film, all you need is a camera with an *f*.6.3 (or faster) lens, and two or three Mazda Photoflood bulbs. (See diagram below.) Hold camera in your hands—as you would outdoors. Read the simple instructions. Follow them and find a new picture-taking thrill—tonight.

To owners of Brownies and inexpensive folding cameras . . . Here are two ways you can take this picture tonight. One—use a Photo*flash* bulb. Load with Kodak "SS," particularly adapted to night picture taking, or Verichrome Film, which will also give very good results. Set camera on a table . . . open for "time" exposure, flash bulb, close shutter. Another—set camera on a table. Watch your chance when baby isn't moving; make a quick "time" exposure. Use Mazda Photo*flood* bulbs. Load with Kodak "SS" or Verichrome Film. See your dealer for information . . . or write for folder.

Here's how you do it



Use one Mazda Photoflood bulb in lamp A . . . two in lamp B, distances as indicated. Tip shades to concentrate light. Load camera with Kodak "SS" Film. Stand 5 feet or more from subject, depending on camera. Lens at *f*.6.3. Exposure 1/25 second. Click camera—you've made the picture.

Here's all you need

KODAK "SS"—the super sensitive film particularly adapted to night picture taking. Comes in the familiar yellow box.

MAZDA PHOTOFLOOD BULBS—give brilliant light, last for many pictures . . . cost but 25c. Any camera with an *f*.6.3 lens or faster will make night snapshots.

KODAK JUNIOR SIX-20—with *f*.6.3 Anastigmat lens is ideal. Pictures 2¼" x 3¼"—price $13.50. Kodak Junior Six-16, with *f*.6.3 lens, pictures 2½" x 4¼"—$15.50.

Ask your dealer about the current $2500 Prize Contest for Night Pictures. All amateur picture takers eligible.

FREE FOLDER

Gives complete instructions on night photography . . . suggests subjects . . . tells you how to make pictures at night with Brownies and inexpensive folding cameras . . . Eastman Kodak Company, Rochester, N. Y.

Name_____

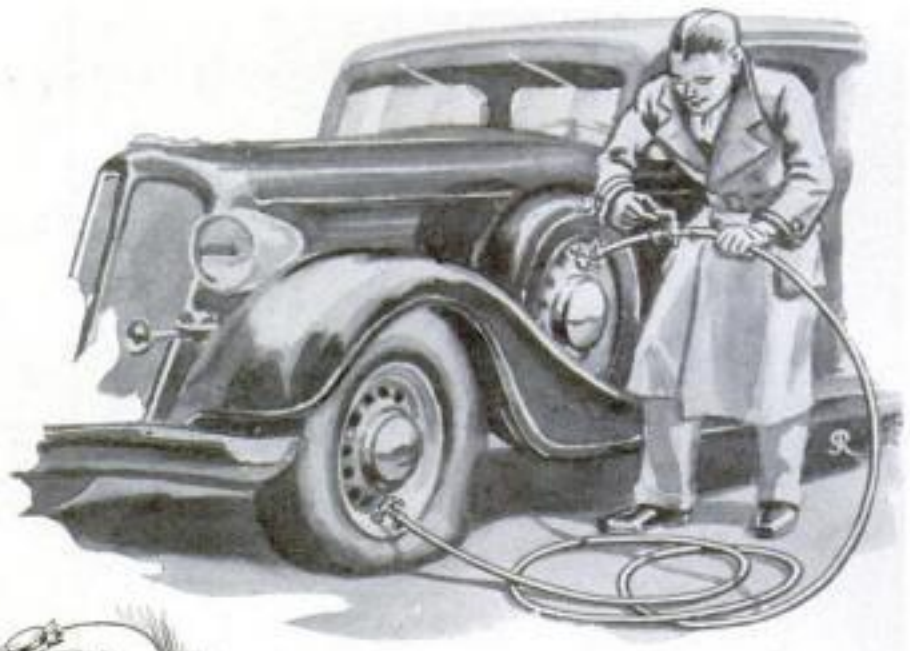
Address_____

City_____ State_____ P. S. 11-35

Timely Aids *for* Autoists

Readers Tell of Inexpensive Ways
They Remedied or Prevented Troubles
Commonly Encountered by Motorists

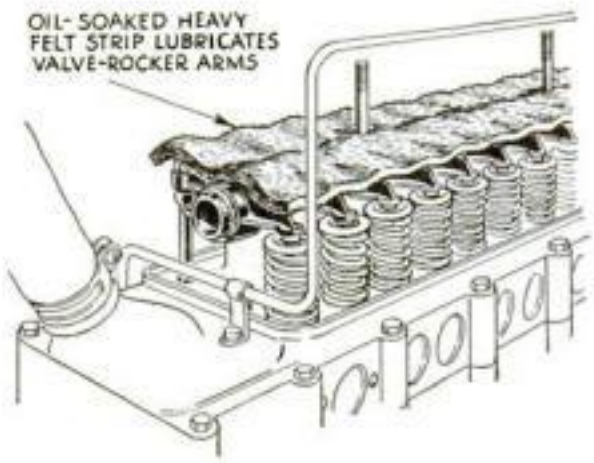
AS A substitute for a tire pump, I carry in my car eighteen feet of tubing, fitted with a petcock near one end and snap-on valve-stem connectors at each end. When a tire develops a slow leak, I simply use the hose to transfer air from my spare and the other tires to the soft one. The borrowed air builds up enough pressure to get me to a garage. —E. E. McG.



If a slow tire leak develops, getting to a garage is made easy by taking air from the other tires via a hose equipped with petcock and valve connectors

Oiler for Rocker Arms

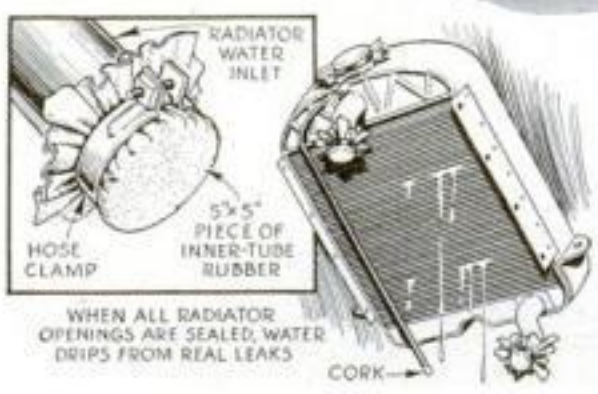
THE rocker arms for end cylinders of valve-in-head motors sometimes run dry due to oil leaking out at the other rockers along the way. To remedy this, install a felt strip over the rockers. The excess oil at the center rockers will be soaked up by the felt and carried to the end units.—E. J. N.



Packing Old Water Pump

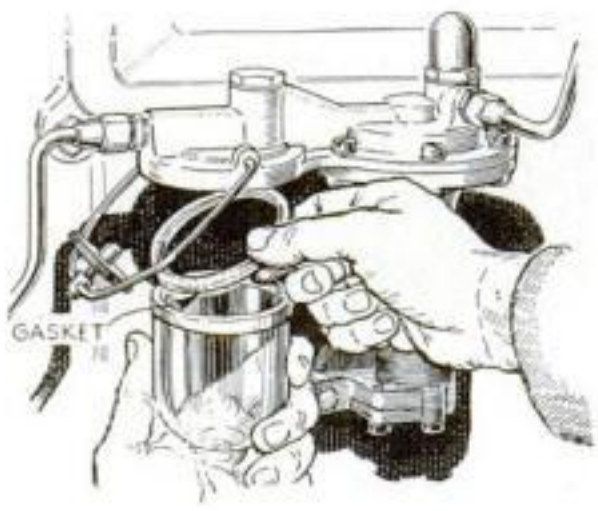
IF YOU are having trouble packing a worn water pump, here is a stunt that is worth trying: Instead of the usual packing, take a length of solid wire solder, wind it around the shaft, and squeeze it home with the packing nut. The solder will wear in and fill completely all the uneven surfaces in the shaft.—G. M. W.

Wire solder is wound around shaft for packing



Testing Leaky Radiator

WHEN using the water test to locate radiator leaks, the problem of plugging the inlet and outlet pipes presents itself. An efficient method consists of cutting two five-inch squares from an old inner tube and fastening them in place over the openings with hose clamps. A rubber square can be used to seal the filler opening if the cap gasket is worn. Finally, a wooden plug forced into the overflow pipe completes the water-tight job. Once sealed, any water that appears comes from a leak in the core.—J. P.

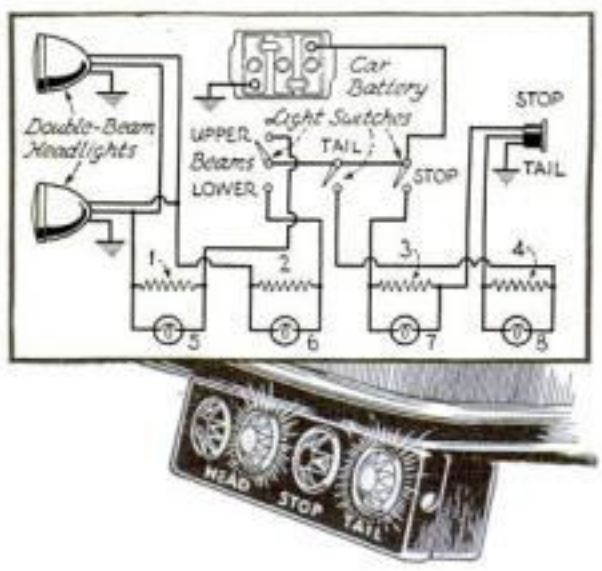


Reversing Gasket Makes It Fit Like New One

AFTER cleaning a gasoline filter bowl, it is sometimes difficult to reassemble it and prevent leakage. This can be avoided, however, simply by reversing the cork gasket. Continuous pressure of the bowl against the cork forms an irregular surface or ridge. By turning the gasket over, the flat side of the cork is placed in contact with the bowl edges, allowing a new seat to be formed.—W. G. L.

Dashboard Pilot Lights

WITH the pilot-light panel, shown below, installed on your dashboard, you can tell at a glance just how your headlights, tail light, and stop light are functioning. This easy-to-install arrangement consists simply of four small bulbs which are mounted behind red-jewel windows and are connected into the lighting circuit of the car as indicated. The values of the resistances used (1, 2, 3, and 4) will, of course, depend on the type of bulb used. They should be just large enough to allow the pilot light to glow without causing any appreciable dimming of the car lights. —L. P.



Jeweled dashboard lights tell how car lights are working. The diagram gives wiring circuit

Fixing a Cracked Battery

WHEN a crack develops in a storage-battery case, an emergency repair often can be made with the materials found in a tire-repair kit. First prop up the battery so that the liquid does not leak out. Then, after washing and drying the case, clean the crack and roughen the surface. Finally, smear patching cement in and around the crack and, when it has become tacky, press a strip of inner-tube patching material into place. A board and string can be used to clamp the patch in place until the cement has had sufficient time to dry.—N. J.

FORD BATTERIES

HAVE TO BE GOOD

Battery capacities are accurately measured by these sensitive electric meters. Specific gravity and temperature readings are taken for each test.

For cold tests the batteries are placed in special refrigerators where below-zero temperatures create conditions encountered in winter driving.

After testing, batteries are torn down for careful internal inspection to determine the condition of plates, separators, electrolyte, cell covers and container.

Testing laboratories throughout the Ford plant safeguard Ford quality. Battery testing is a typical example.

The battery laboratory is continually testing production batteries to see that they always measure up to specifications. A battery has to be good to retain 85 per cent of its original efficiency after 45 discharges and 45 recharges with 100 per cent overcharge each time. Ford batteries meet this test.

The ability of the Ford battery to crank an engine is constantly checked. This test is as severe on a battery as holding a starter button down for more than eight minutes —something no driver would ever do.

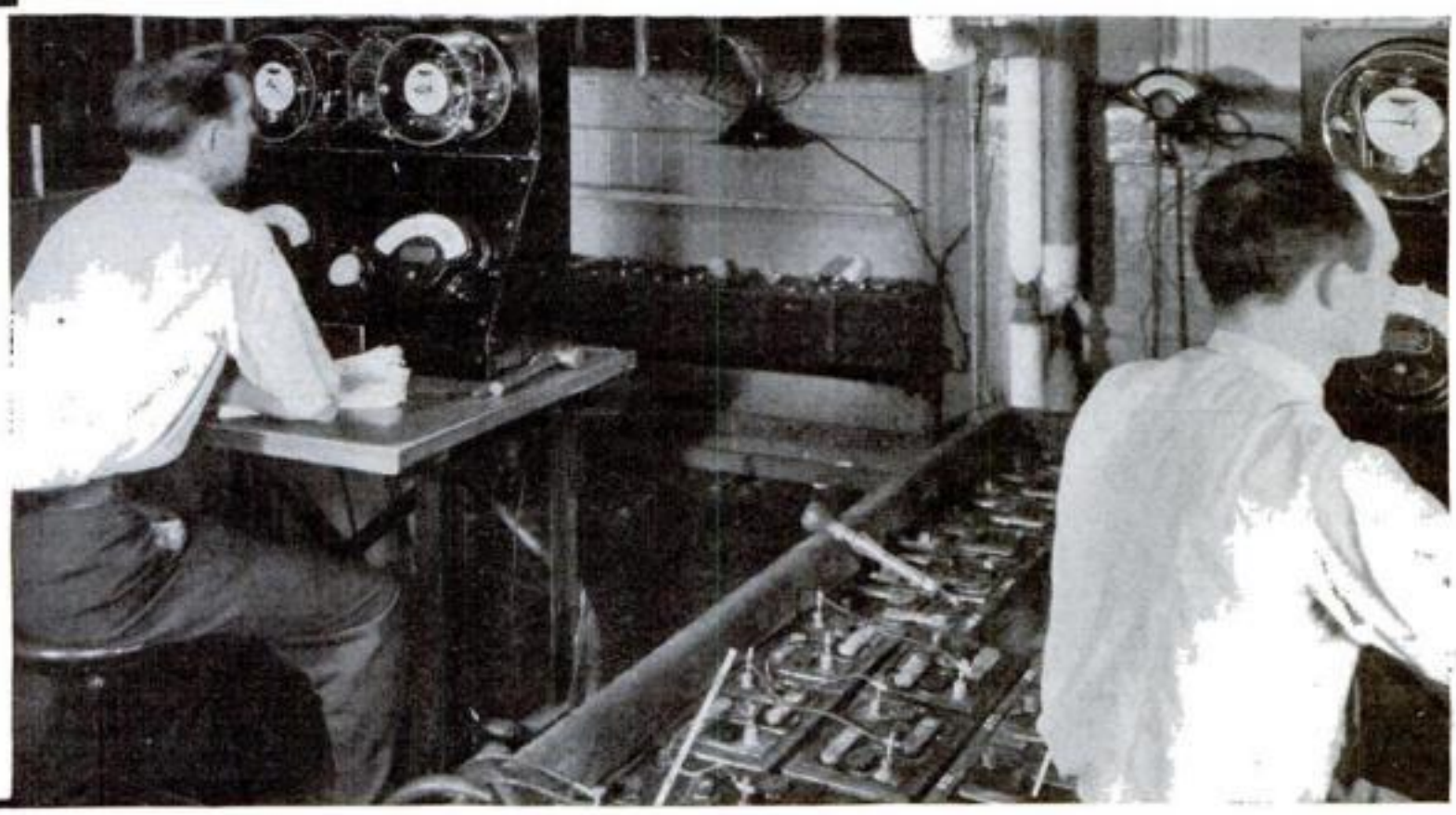
In the constant overcharge test, fully charged batteries receive a 10-ampere charge continuously, day and night for thirty days. This approximates a 2000-mile non-stop run at 25 miles per hour without once using the horn, lights or starter.

The reason Ford batteries can meet these and other severe tests is that there is no skimping on plate area, plate thickness or quality of materials. When your battery needs replacing it will pay you to get a Genuine Ford Battery.

Ford

FORD MOTOR COMPANY

DEARBORN, MICHIGAN



The Ford Battery Laboratory is equipped with every scientific device for determining quality. Batteries undergoing normal discharge test are in tank which automatically maintains battery electrolyte at constant temperature.

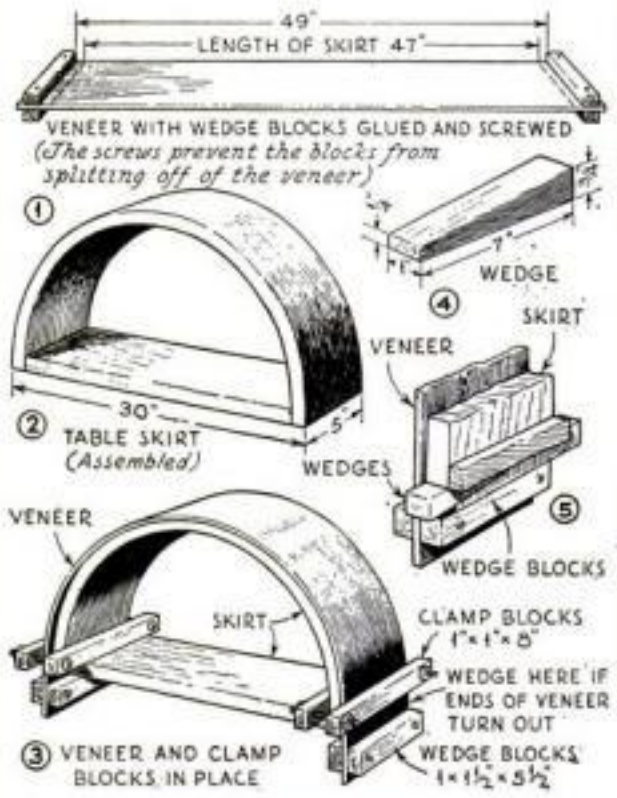
If you like POPULAR SCIENCE MONTHLY why not pass the word along to your friends. When an article in this magazine strikes you as being unusually good, tell your friends to get a copy at the newsstand, and read it.

HOW TO VENEER SKIRTS OF HALF-ROUND TABLES

MANY amateur woodworkers would make attractive half-round end tables and similar pieces if they knew how easy it is to veneer the circular skirts.

When the skirt is ready to be veneered, cut the veneer ½ in. wider and 6 in. longer than necessary. Let us assume the dimensions are as in Figs. 1 and 2. Next prepare four blocks 1 by 1½ by 5½ in. and fasten them to the veneer in pairs with glue and two 1¾-in. wood screws as shown in Fig. 1. Make two clamps as in Fig. 3, and bore them in pairs for 4 by ¼-in. bolts, 6½ in. apart. Also make four wedges, Fig. 4.

Use cold water or prepared liquid glue, as hot glue chills before the joint can be made. Apply glue to 3 in. at one end of veneer and skirt and place veneer on skirt. Fasten one set of clamps as in Fig. 3 with only enough pressure to keep them in position. Apply glue on



The veneer is clamped tightly against the curved surface by driving wedges where shown

the remainder of veneer and skirt. Bend veneer around skirt and fasten the other set of clamps. Between the ends of the circular skirt and the blocks on the veneer, insert wedges as in Fig. 5. Press veneer with hands, working from center to ends, as in massaging. If the ends of veneer turn outward, place a pair of wedges as indicated in Fig. 3. Drive these wedges only hard enough to keep the work in position.

When the glue is thoroughly dry, remove wedges and clamps, and trim veneer to size of skirt. Always veneer round table skirts before attaching the legs. To veneer a skirt in this way with the grain of the veneer vertical, or across the skirt, first glue the face veneer across the long piece, as in cross-band veneer, and proceed as before.

If it is desired to use a crotch, burl, or other fancy veneer in which there may be bulges, substitute for the veneer in Fig. 1 a piece of tin or galvanized sheet iron not heavier than 26 gauge. Attach the wedge blocks with three screws, but otherwise the same as Fig. 1. Join up with paper tape all the pieces of veneer until about 1 in. larger than skirt. Apply glue to surface of skirt and place veneer on skirt. Drive two or three ½-in. No. 20 brads at center to hold veneer. Apply band clamps as previously described and insert wedges as before. Drive hard enough to bring all parts of veneer in contact with core. Light tapping over bulges in the veneer with a rubber mallet or a felt sand block under the hammer is helpful in obstinate cases.—R. C. STANLEY.

New 1936 TOOLS By "Delta"

If you are at all interested in motor-driven tools for use in home workshops, factories, farms, construction work, or small shops, be sure to see the new 1936 Delta line. The efficient performance, rugged precision construction, and fine workmanship of these compact economical tools are a revelation. You will understand then why Delta tools are used and recommended by tens of thousands workshop owners all over the world

The Delta line includes Circular Saws, Jointers, Lathes, Scroll Saws, Band Saws, Routers, Shapers, Grinders and a complete assortment of attachments and accessories

New Delta Shaper Unit

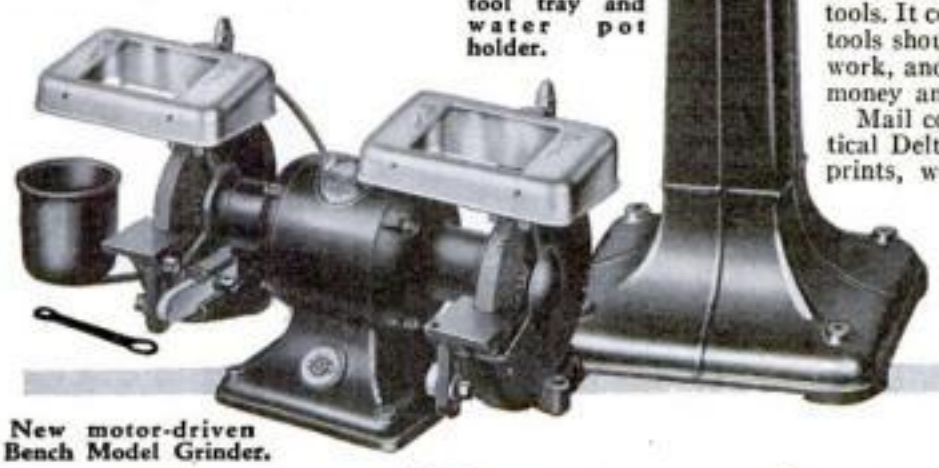
here illustrated is one of the simplest and at the same time most complete Shapers ever designed for the workshop. Some of its important basic features are: 1. Extra Large Table permitting the handling of large work with ease; 2. Interchangeable Spindles for 5/16" and ½" hole cutters for various types of work; 3. Improved Completely Adjustable Fence for all varieties of straight work; starting pin for curved work of all kinds; 4. Complete Guarding system; 5. High Speed of 10,000 R. P. M. which with standard 3-lip Delta cutter gives over 30,000 cuts a minute, thus insuring smooth and finished work; 6. Complete range of cabinet and sash cutters for all types of mill work.

For full details and description of this unusual tool together with illustrations of large variety of work that can be done with it, send coupon for the new 1936 Delta Catalog.

Pedestal model motor - driven Grinder with built in switches, water pots, and combination tool tray and water pot holder.

Complete New Line of Advanced GRINDERS

Not just another line of grinders—but revolutionary *new* grinders in every sense of the word! Belt-driven, motor-driven and pedestal models—they all embody Delta's high standards of design and construction. No pains have been spared to make these new Delta Tools *ideal* in every way—convenient, safe, accurate and efficient—truly, here are the grinders that shopworkers have always wanted—and at the unusually moderate Delta price levels.



New motor-driven Bench Model Grinder.

Write for 1936 Catalog

It is crowded with photographs and information about the new line of 1936 Delta tools. It contains much valuable information that every man interested in wood-working tools should have. It shows how Delta tools are built to stand the grind of production work, and yet are so low priced as to be within the reach of all, how they save time, money and labor—and quickly pay for themselves.

Mail coupon without delay. Enclose only 10 cents at same time for Book of Practical Delta Projects, 32 pages of new and novel things to make, with numerous blue prints, working drawings, photographs and illustrations—and complete directions.

Delta Manufacturing Company
600-634 E. Vienna Ave. [Dept. B1135] Milwaukee, Wis.

DELTA MANUFACTURING COMPANY,
600-634 E. Vienna Ave., Dept. B1135
MILWAUKEE, WISCONSIN

I enclose 10c (stamps or coin), for which please send me one copy of "Practical Delta Projects". Also place me on your mailing list to receive 1936 Delta catalog of quality motor-driven wood-working tools.

Name.....

Address.....Age.....

City.....State.....

☐ Check here if you are a Delta user now.

Delta **QUALITY** *represents real* **ECONOMY**

Craftwork displayed at the annual exhibition of the Middletown (Conn.) Homeworkshop Club

How to Start a HOME WORKSHOP CLUB

Official Magazine POPULAR SCIENCE MONTHLY

EVERY ONE interested in the hobby of making things should belong to a home workshop club. The friendly and stimulating companionship will enable you to do more and better work and get a lot more fun out of it.

This has become well recognized since POPULAR SCIENCE MONTHLY began to urge readers to form clubs about two years ago, because 181 local clubs have already been organized and granted charters by the National Homeworkshop Guild.

A list of the cities and towns in which clubs are established is given in another column. In the smaller places it is usually easy to find out where a club meets by asking any of the local hardware dealers, but if you are unable to get this information, just send a self-addressed, stamped envelope to the Home Workshop Department and ask for the address of the secretary of the club nearest to your home.

As yet there are not nearly enough clubs to meet the demand. You are very likely to find that there is no club in your own locality, even if there is one somewhere else in the same city. A home workshop club really should be a neighborhood affair, where the members live within a few blocks or at most a mile or two of one another. The thing to do, then, is to start a club of your own. The steps are simple, the expense trifling, and the work nominal, yet the satisfaction you will get is certain to be beyond all expectations. Here is what you should do:

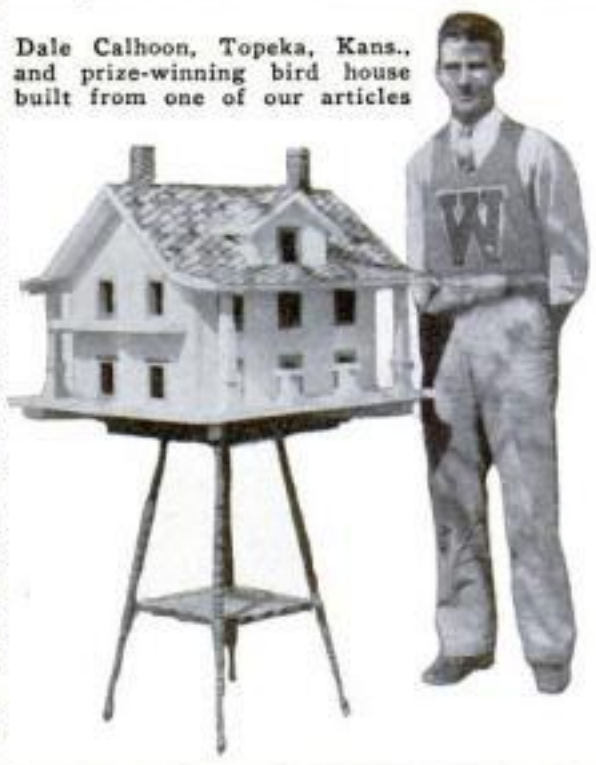
First get a few friends to help you in organizing the club. Make a list of those you think might like to join. Visit local hardware, lumber, and paint dealers and ask them to give you the names of some of their customers who are amateur craftsmen. Visit the local school and talk to the manual training teacher, if there is one.

When you are assured of five or more members, call an organization meeting. This can be held in the home of one of the men unless you expect a fairly large crowd, in which case you can easily arrange for a meeting room in a school, a church hall, a club, a hardware store, or possibly in some industrial plant. Send notices of the meeting to the local papers.

When the meeting is held, have a temporary chairman elected and open nominations for officers. These may be temporary officers, if you wish to defer a final decision to the following meeting. As soon as the officers are chosen, let a committee be appointed—three members should be sufficient—to draw up the constitution and by-laws and report at the next meeting. Decide upon a good name. The majority of clubs have names like the following: Bristol Homeworkshop Club; Iroquois Homeworkshop Club of West Springfield, Mass.; Leatherstocking Homeworkshop Club of Cooperstown, N. Y.

If the members wish to become affiliated with the National Homeworkshop Guild, an application for a charter will have to be filled out on a special form required by that organization from all applicants. It is necessary to list names and addresses of officers and members, give the proposed name of the club, and remit the first year's dues, which are fifty cents a member.

Suggestions for a charter may be found in various handbooks and manuals on parliamentary law. Article I should give the name of the



Dale Calhoon, Topeka, Kans., and prize-winning bird house built from one of our articles

Where Home Workshop Clubs Are Located

Akron, Ohio
Alliance, Nebr.
Amarillo, Texas
Antioch, Calif.
Ashtabula, Ohio
Atlanta, Ga.
Auburn, Calif.
Austin, Texas
Beckley, W. Va.
Billings, Mont.
Bloomington, Ind.
Bluefield, W. Va.
Borden, Ind.
Bridgeport, Conn.
Bristol, Conn.
Bristol, Tenn.
Brookhaven, Miss.
Brunswick, Me.
Buffalo, N.Y.
Charlotte, N. C.
Chester, Pa.
Cheyenne, Wyo.
Chicago, Ill. (2)
Cicero, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Cody, Wyo.
Coleman, Alberta, Can.
Collingswood, N. J.
Cooperstown, N. Y.
Covington, Ky.
Creston, Iowa
Cudahy, Wisc.
DeKalb, Ill.
Denison, Iowa
Denver, Colo.
Detroit Lakes, Minn.
Dixon, Ill.
Dunkirk, N. Y.
East Norton, Mass.
Eau Gallie, Fla.
Elizabeth, N. J.
Elmhurst, Ill.
Elmira, N. Y.
Emmetsburg, Iowa
Erie, Pa.
Eugene, Ore.
Evansville, Ind.
Fairfield, Ala.
Fairmont, W. Va.
Fargo, N. Dak.
Fayetteville, W. Va.
Flint, Mich.
Fort Dodge, Iowa
Fort Wayne, Ind.
Freeport, Ill.
Freeport, N. Y.
Gainsville, Fla.
Galesburg, Ill.
Glen Lyon, Pa.
Great Falls, Mont.
Hammond, Ind.
Hampton, Va.
Hoboken, N. J.
Holton, Kans.
Hornell, N. Y.
Indiana, Pa.
Jacksonville, Fla.
Janesville, Wisc.
Jersey City, N. J.
Kalamazoo, Mich.
Kewanee, Ill.
Kincaid, Kans.
Kingsville, Texas
La Grange, Ill.
Lansdale, Pa.
La Porte, Ind.
Lawrence, Mass.
Le Roy, N. Y.
Lexington, Ky.
Lincoln, Nebr.
Little Rock, Ark.
Louisville, Ky.
Lowell, Mass.
Maddock, N. Dak.
Madison, Wisc.
Manchester, N. H.
Manitowoc, Wisc.
Marshalltown, Iowa
Maywood, N. J.
McKeesport, Pa.
Memphis, Tenn.
Menomonie, Wisc.
Miami, Fla.
Miles City, Mont.
Middletown, Conn.
Mobile, Ala.
Moose Jaw, Sask., Can.
Morristown, N. J.
Mount Clemens, Mich.
Mount Vernon, N. Y.
Nampa, Idaho
Newark, Ohio
New Bedford, Mass.
New Britain, Conn.
Newcastle, Calif.
New Egypt, N. J.
New York, N. Y.
Niagara Falls, N. Y.
Norristown, Pa.
North Manchester, Ind.
North Tonawanda, N.Y.
Oakland, Calif.
Ocala, Fla.
Oklahoma City, Okla.
Orange, Mass.
Ottumwa, Iowa
Paradise, Mont.
Pasadena, Calif.
Patchogue, L. I., N. Y.
Patillas, Porto Rico
Peekskill, N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
Port Leyden, N. Y.
Poughkeepsie, N. Y.
Provo, Utah
Red Wing, Minn.
Richmond, Ind.
Richmond, Va.
Rochester, N. Y.
Rockford, Ill.
Roseburg, Ore.
Saginaw, Mich.
San Diego, Calif.
San Jose, Calif.
Scranton, Pa.
Seattle, Wash.
Sharon, Pa.
Sharpsburg, Pa.
Sheffield, Ill.
Sheridan, Ill.
Silverton, Colo.
Smith Center, Kans.
Snoqualmie, Wash.
South Sioux City, Nebr.
Spokane, Wash. (2)
Springfield, Mass.
Stroudsburg, Pa.
St. Charles, Ill.
St. Joseph, Mo.
St. Louis, Mo. (2)
St. Louis, Okla.
Sterling, Ill.
Syracuse, N. Y.
Tacoma, Wash.
The Dalles, Ore.
Three Rivers, P.Q., Can.
Toledo, Ohio
Topeka, Kans.
Tucson, Ariz.
Tulsa, Okla.
Two Rivers, Wisc.
Vineland, N. J.
Warren, Ohio
Washington, D. C.
Waukegan, Ill.
Waupaca, Wisc.
West Point, Va.
West Springfield, Mass.
West St. Louis, Mo.
Wethersfield, Conn.
Wichita Falls, Texas
Wood-Ridge, N. J.
Yakima, Wash.
Yreka, Calif.
Zanesville, Ohio

club, and Article II its object, which may be expressed as the promotion of active interest in home workshop handicraft by the interchange of ideas. It is well to state that none of the club activities are to be carried on for profit to the club. Article III can state what officers there are to be, usually a president, secretary, and secretary-treasurer in small clubs. Article IV can provide for a board of governors, the usual membership being the officers of the club and three other active club members. Other articles can cover the qualifications of members, elections, dues, meetings, order of business, vacancies, what constitutes a quorum, and how amendments to the constitution may be made.

Another important *(Continued on page 79)*

LIGHT METER AIDS IN ENLARGING

(Continued from page 70)

could be worked out in a number of different ways. At first glance the simplest method would appear to be to use a rheostat. However, rheostats suitable for controlling a single electric light bulb from dark to full brightness are difficult to obtain, expensive, and bulky. Another method would be to mount the electric bulb in such a way that it could be moved farther away from, or closer to, the surface to be lighted. Experiments were made with this method, also. It works well, but the ungainly length of the resulting exposure meter and the mechanical construction of the slide mechanism are vital objections.

BY PLACING the light bulb to one side as shown, with a curved white reflector under the surface to be illuminated and a slide to control the amount of light that reaches the reflector, a uniformly lighted panel and complete, smooth control of the light are obtained in the simplest possible way.

The first job is to make the box. The inside dimensions are roughly 2½ by 2½ by 8½ in. If you are handy with woodworking tools or you like to work with sheet metal, use wood or metal. If not, a satisfactory box can be made of heavy cardboard. If you use the latter material, provide a cord switch so that the light can be turned off except when you are making a light measurement.

In any case the most important requirements are that the box be reasonably light-tight and that the size and shape of the box and reflector be approximately as shown.

In the location shown, cut a window in the top of the box exactly 2 in. square and fit some sort of beading that will support 2-in. squares of ground glass or opal glass. If you make the box of wood, you will find that four ordinary wooden safety matches, when glued in place, will do nicely to form the ledge on which the glass squares may rest.

The reflector can be made of stiff white drawing paper held in place with small tacks along the lower edge. If made of metal, it should be painted with at least three coats of flat white paint. The fitting of a porcelain socket for the electric light bulb presents no special problem.

If you have no facilities for grooving the sides for the slide, equally good results will be obtained by cementing wooden matches in place to act as guides. The slide can, of course, be made of any available sheet metal or stiff cardboard.

The first step in calibrating the exposure meter, after screwing an ordinary 15-watt bulb into the socket, is to get the lighted panel on the exposure meter as bright or a trifle brighter than the lighted surface produced on a piece of white paper on the easel when no negative is in the enlarger and the lens is set to its largest opening if it happens to be adjustable. This adjustment should be made with the slide all the way up, of course, but before you make it you must decide in which of two ways you prefer to use the meter.

ONE way is to make each test with white light before the enlarging paper is put in place, a dummy piece of white paper being used instead; and the other is to fit a red screen over the enlarging lens and another of exactly the same color over the illuminated panel of the meter. The second method is much the better, first because it is more accurate owing to the difficulty of getting exactly the same shade of white light from both the enlarger and the meter, and second because it saves time.

The simplest way to obtain precisely matching colors, is to use the same filter over the lighted meter surface that you do over the enlarging lens. A suitable filter is the red A filter in the Wratten series of inexpensive gelatin filters. This filter comes in 2-in. squares. Drop one into the panel in the exposure meter and cut the other into a circle to be fitted to a cardboard lens cap.

When both filters are in place, the brightness of the meter light with the slide all the way up is adjusted to match the light on a piece of paper on the easel by adding squares of thin typewriter paper to the meter opening till you strike the right combination. These, together with the gelatin filter, can be placed between two squares of ground glass or opal glass.

The next step is to calibrate the slide. If you happen to have on hand a number of negatives of different density the correct enlarging times of which are known, it is merely a matter of placing the negatives in the enlarger, matching the brightest portions by pulling out the meter slide, and marking lines across the latter with exposures in seconds or minutes as the case may be.

If you haven't any such negatives, then you will have to proceed by trial and error, marking the slide each time you hit the right exposure for a negative of different density.

ONCE you have the meter completely calibrated, you will find that you will rarely spoil a sheet of paper through incorrect exposure, provided your method of development gives a reasonably uniform degree of contrast in your negatives. Remember that when the exposure of the negative in taking the picture is within the latitude limits of the film, variations in exposure only change the density of the negative. The degree of contrast is controlled almost entirely by the lighting of the subject when the picture is taken and by the length of development.

So if you are careless in developing your negatives and you get one batch thin and flat and the next so harsh and contrasty that they give soot-and-whitewash effects when printed even on soft paper, you will have to make some allowances in enlarging time. For thin, flat negatives give a little less time than indicated by the exposure meter. For harsh, contrasty negatives, add twenty-five to fifty per-cent to the meter time. Experience will soon guide you in this respect.

When you use this meter you can forget about any differences in exposure time caused by changing the scale of the enlargement or by changing the diaphragm opening of the enlarging lens. Since the meter measures the actual intensity of the light on the surface of the paper, it will give you the correct exposure no matter what the scale of enlargement or the opening of the lens diaphragm.

It will be apparent that exactly the same method of using the meter will work out with any of the ordinary printing machines where the light is underneath the negative and the paper is placed on it, face down. If you print with an ordinary printing frame held up to a light, then it will be necessary to make a dummy illuminator for your negatives and also to standardize on one size of electric light bulb and a fixed distance between the printing frame and the light. The illuminator can take the form of a simple box like the meter with a panel of the same size, but without any sliding light control. Use a filter to get the necessary color match for the reason previously explained.

To determine the printing speed of a negative, the most important portion of it will be held against the illuminator panel, and the meter panel adjusted to match. Of course, the meter will have to be calibrated by test, and the marks can be made on the other side of the slide so that one side will be calibrated for enlarging and the other for printing.

HOW TO START A HOME WORKSHOP CLUB

(Continued from page 77)

matter to attend to is the appointment of a capable member to look after publicity. Nothing is more important to the successful growth of a club than adequate and informative reports in the newspapers. Prepare an account of the meeting with the names of the officers elected and send it immediately to the local papers. In a small town, include the names of all present. Mention when and where the next meeting is to be held. A brief announcement should also be given to the papers just before the second meeting. Make it clear that all men interested in the home workshop hobby will be welcome.

At the second meeting, elect permanent officers if that was not done at the first, and adopt the constitution and by-laws after discussing each section and modifying it, if necessary, until it meets with general approval. Let each man present give his ideas on club activities, programs, and projects. Find out what particular branches of craftsmanship each member is most interested in. In general, lay a foundation for future meetings. It is a good plan to have one of the officers or a member make a report on what other clubs are doing.

This can be done very easily by consulting back issues of POPULAR SCIENCE MONTHLY and making notes of the various activities described in the club news columns.

With very few exceptions, the clubs meet every two weeks. Some clubs have a business meeting only once every four weeks, the alternate meetings being given over to demonstrations, visits to workshops, and other activities. A few clubs have additional informal meetings at the shops of various members for the purpose of working on projects. In such cases a project committee is appointed to supervise the work and arrange for materials.

POPULAR SCIENCE MONTHLY is the official magazine of the entire home workshop club movement. Be sure therefore to send a prompt report of the organization, followed later by reports of all activities, to this magazine. Include any noteworthy clippings from local papers about the club and any photographs you have taken of unusual projects, home shops, special club demonstrations, or other undertakings of general interest. We shall be glad to announce the formation of all new clubs as soon as we receive the details.

JEWELRY MADE FROM CELLULOSE TAPE

COLORED cellulose tape or ribbon, in the widths used for tying packages, can be used for making novel and durable yet light rings and bracelets. The ribbon is made in many styles and color combinations, so that a color to match any costume can be selected.

Cut a wooden disk of the proper diameter for forming the bracelet, and use a dowel or other round stick as a core for winding the ring. As the ribbon is wrapped around the form, coat it freely with transparent cellulose household cement thinned as necessary with acetone, or a cement made by dissolving scraps of transparent celluloid in acetone. From fifteen to twenty-five turns are necessary, according to the thickness desired. Lay the completed rings and bracelets aside to dry.

Cellulose Scotch tape, which is adhesive on one side, also may be used for many decorative purposes.—K. M.

A colorful ring and bracelet to match formed by cementing together cellulose ribbon

How the ring was made by winding the tape around a wooden stick for about twenty-five turns and fastening the whole with transparent cement

START MAKING GIFTS FROM OUR PLANS

NOW is the time to begin planning those Christmas presents you intend to construct yourself. Our list of blueprints will provide any number of good suggestions.

The following titles are only a few of the famous POPULAR SCIENCE MONTHLY blueprints. If you do not find what you want here, send a self-addressed, stamped envelope at once for our complete list.

FURNITURE

Bookshelf and Book Ends, Modern, *100*	.25
Child's Costumer, *179A*	.25
Coffee Table with Spiral Legs, *245A*	.25
Fireside Seats (wood and metal), *266A*	.25
Floor Lamp with Tripod Base, *243A*	.25
Lamps, Modern (no turning), *93*	.25
Magazine Rack, Ladder-Back Style, *250A*	.25
Pier Cabinet and Hanging Shelves, *77*	.25
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Table, Four-Leaf Card, *239A*	.25
Tavern Table and Scroll Mirror, *105*	.25

MISCELLANEOUS

Night Lamp and Sewing Kit, *255A*	.25
Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Hand Loom, Four-Treadle, *268A-269A*	.75
Projector for Photos and Pictures, *259A*	.25
Six Simple Block Puzzles, *65*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

RADIO SETS

All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Five-Tube Short Wave (A.C. or D.C.), *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

BOATS

*Duck Boat, Folding, *170-R*	.50
High-Speed Boat for Small Outboard Motors (7 ft. 11 in. long), *257*	.25
Installing Inboard Motors, *270*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*	.50
*13-ft. Racing Runabout, *261-262-R*	.75

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra.

SHIP AND COACH MODELS

{ Construction kits are available for some of these models. See page 6. }

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in.), *226-227-R*	.75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Brooklyn* (8-in.), *236*	.25
Cruiser *Tuscaloosa* (11¾-in.), *234*	.25
Freighter, Ocean (14-in.), *271*	.25
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
H. M. S. *Bounty* (8½-in. hull), *254*	.25
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Aquitania* (9-in.), *225*	.25
Liner—*California* (12½in.), *251*	.25
Liner—*Normandie* (20⅝-in.), *264-265*	.50
Liner—*Manhattan* (12-in. long), *204*	.25
Liner—*St. Louis* (11-in.), *231*	.25
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230-R*	1.00
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Sedan Chair, *123-124*	.50
Show Boat, Illuminated (14-in.), *263*	.25
Stagecoach with horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Steamships *Savannah* (3 in. over all) and *Atlantic* (6 in.), *235*	.25
Trading Schooner (17½-in. hull), *252-253*	.50
"Treasure Island" *Hispaniola* (7-in.), *237*	.25
Viking Ship, (20½-in.), *61-62-R*	.75
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull), *233*	.25
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

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353 Fourth Avenue, New York

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Name .....

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Please print your name and address clearly.

LOVE SEAT IN EARLY AMERICAN STYLE

(Continued from page 63)

List of Materials

No. of Pieces	Description	T.	W.	L.
1	Back post	1 5/16	6	26
1	Seat slats	1 5/16	6	18
1	" front	1 5/16	6	48
1	" back	1 5/16	5	36
2	" ends	1 5/16	7½	22
2	Front legs	2¾	2¾	24
2	Back "	2¾	2¾	15
1	Back slat	1 1/16	4	40
1	" slats	13/16	6	40
1	Drop leaves and butterfly flaps	13/16	10	56
1	Arms	13/16	10	30

NOTE: All dimensions are in inches.

of front legs on the line determined in operation 7, and bore ⅞-in. hole in top.

6. Cut out back posts; shape and fit each to seat with draw-up wedge. Leave slat dovetail mortises till later.

7. With back posts in place, fit horizontal back slats, cut dovetail shape on slat ends, then scribe their outline on back posts. While back posts are still in place, put in front legs, marked with proper cut-off point at upper end, and level across to rear posts with straightedge to locate mortise for rear end of arms. This should be even with upper edge of the middle slat. Then remove posts and cut slat and arm mortises. Glue posts and slats together, first making sure that the posts will still enter their sockets accurately when assembled with slats.

8. Glue legs in place. Rear legs are assembled with wedges driven from the top into wedge-shaped slots sawed in the leg tenons. Use a sharp chisel and scraper to trim off the projecting tenons flush with the top of the seat.

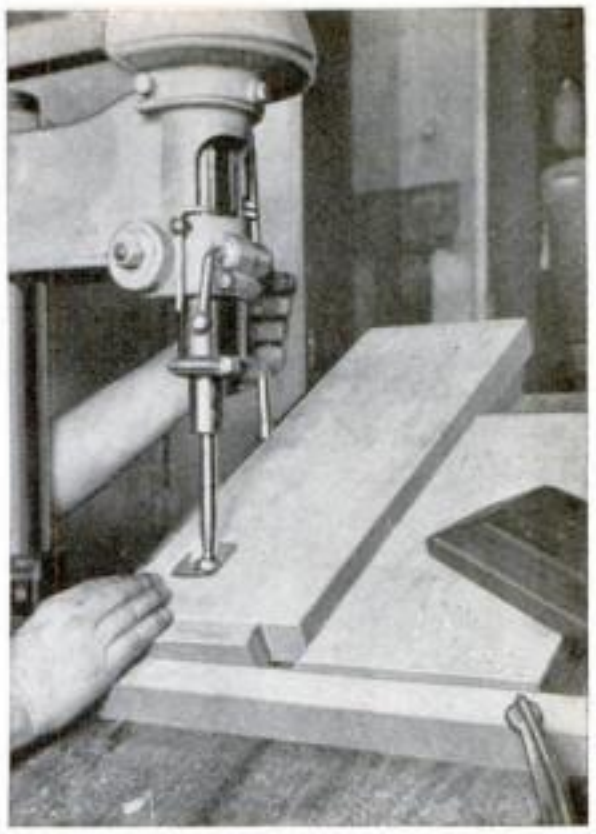
9. Glue the back in place.

10. Make up and fit arms to back and front legs with screws and dowel as detailed. Remove arm and fit rule joint and hinges to drop leaf.

11. Make up butterfly flap. With arm in place, square down from pivot peg glued in underside of arm to locate pivot dowel in seat. Leave this dowel long so that it can be removed from below. See that the flap is properly held up with the wedge stop in place. Take off the flap and drop leaf for finishing, and glue the arm in place.

12. Fit the seat slats and remove for finishing. Instead of the wooden slats shown, the usual interlacing flat steel bands with spiral springs at the ends may be installed. These will give a softer seat.

13. The finish should match other pieces if the settee is to be added to an existing group. The following method produces a lustrous reddish brown shade that brings out the beauty of the grain. First, moisten the piece all over with a wet rag to raise the grain, and sand off the fuzz when dry. Apply Early American water stain and sand lightly when dry. Two coats may be necessary to get the desired tone and to cover up any places exposed by sanding. Rub down hard with steel wool. To darken and produce a deep luster, you may apply a coat of transparent filler darkened with a small amount of walnut stain and thinned with linseed oil and turpentine. Seal with a thin coat of shellac and rub with steel wool. Repeat the shellac coat three or four times, and finally use a good furniture wax.



Boring holes in seat on tilted drill-press table. A router or a Forstner bit is used

The cushions may be obtained from a furniture store. The sizes given, 21 in. square for the spring seat cushions and 19 in. square for the back cushions, are common dimensions. If the cushions are not obtainable in these sizes, you may either have them made up by an upholsterer or alter the settee dimensions to suit sizes readily available.

This settee was built at a cost of $7.50 for the maple, $14.00 for the cushions, and about 50 cents for the hinges and finishing materials.

STUNTS WITH High-Frequency Current

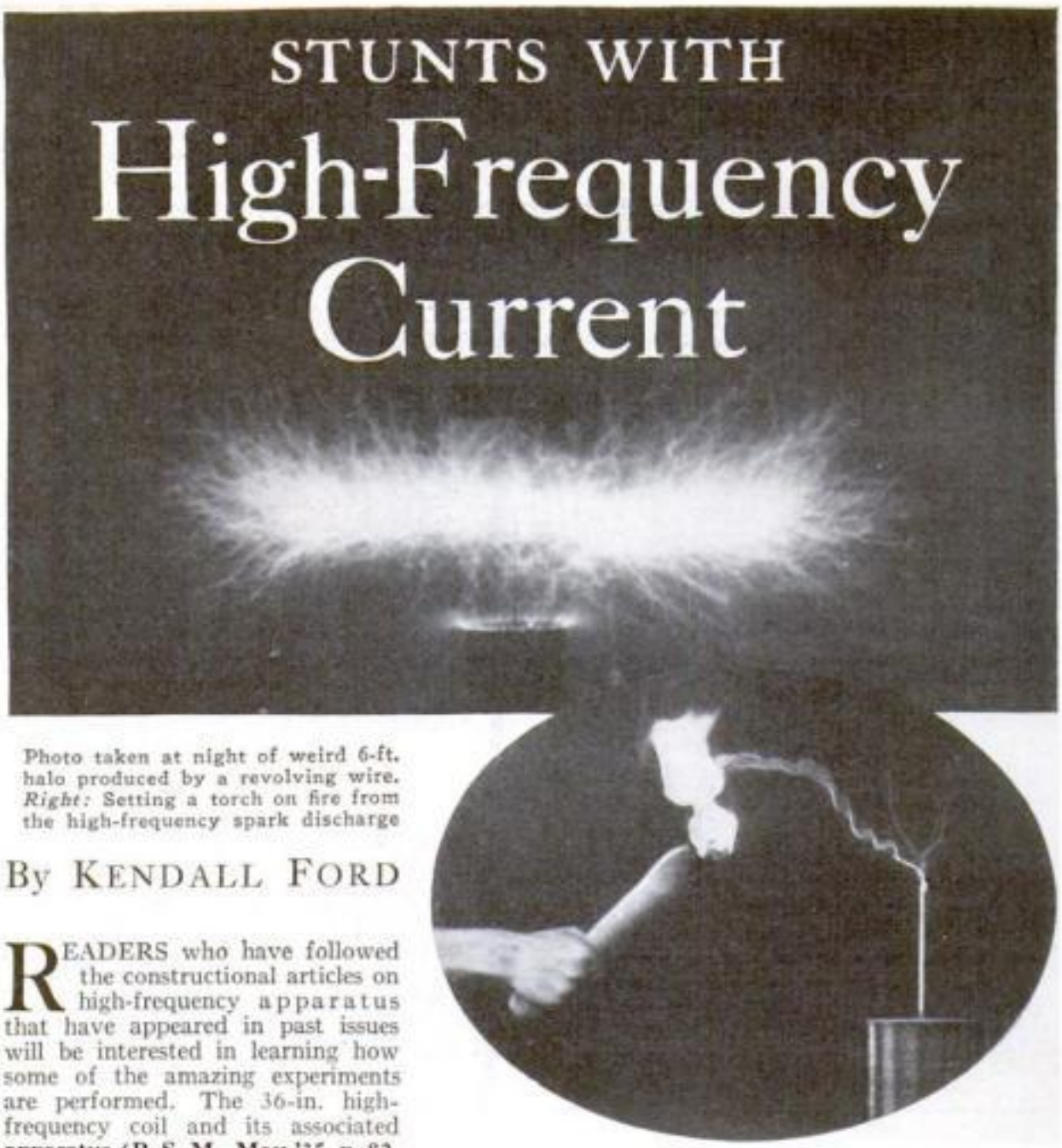
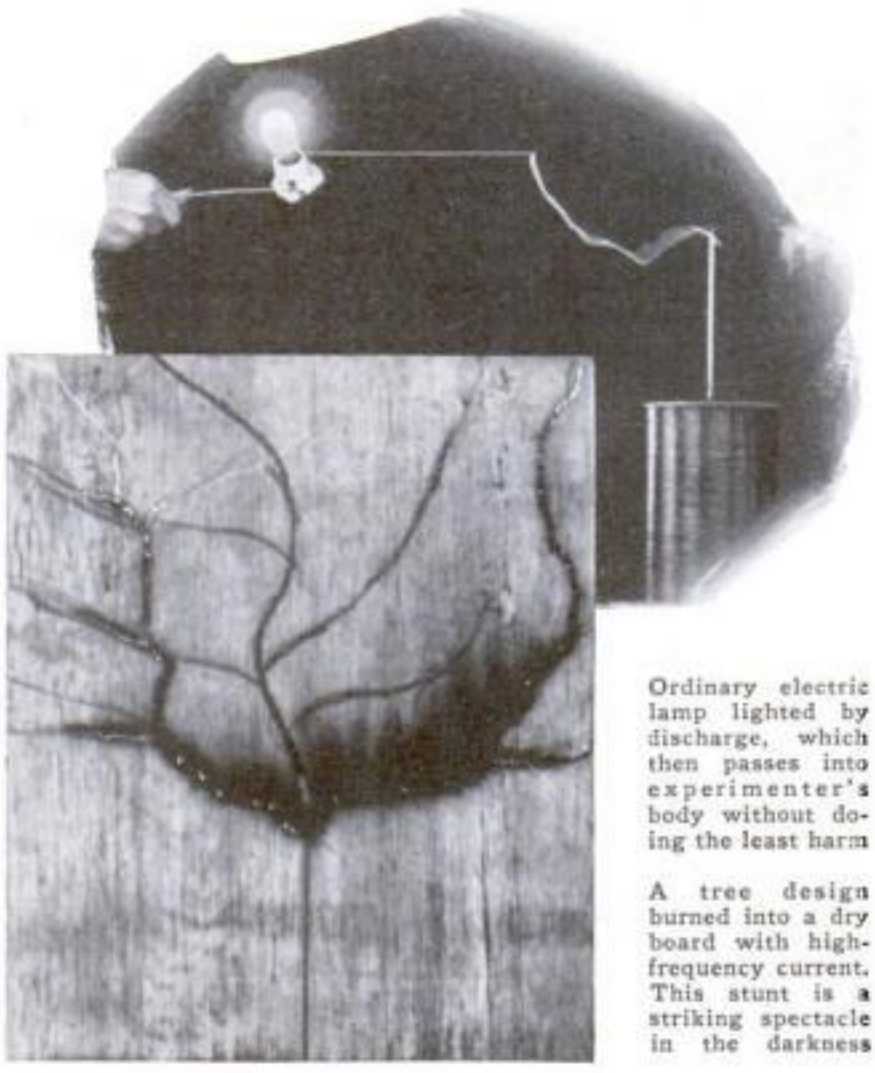


Photo taken at night of weird 6-ft. halo produced by a revolving wire. *Right:* Setting a torch on fire from the high-frequency spark discharge

By KENDALL FORD

READERS who have followed the constructional articles on high-frequency apparatus that have appeared in past issues will be interested in learning how some of the amazing experiments are performed. The 36-in. high-frequency coil and its associated apparatus (P. S. M., May '35, p. 82, and July, p. 82) will be used for the purpose of illustration in this article.

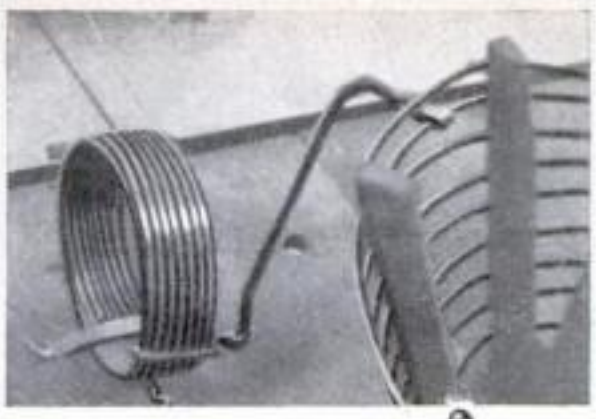
The 110-volt line current is stepped up to approximately 12,000 volts by means of the transformer. The high-voltage current flows from the secondary of the transformer into the condensers, which become charged. If the circuit comprising the condensers, primary of the high-frequency coil, and spark gap has been properly adjusted, the condensers will discharge across the spark gap with a series of sparks, the frequency of which is many times the original 60-cycle charging current.



Ordinary electric lamp lighted by discharge, which then passes into experimenter's body without doing the least harm

A tree design burned into a dry board with high-frequency current. This stunt is a striking spectacle in the darkness

The high-frequency discharge of the condensers is somewhat analogous to the swing of a pendulum. The 60-cycle current that charges the condensers may be likened to the single motion required to start the pendulum from rest, and as the swing of the pendulum will gradually diminish until it comes to a standstill, so will the strength of the discharges from the condensers across the spark gap gradually diminish until the condensers are discharged. These rapid discharges from the condensers occur between the peaks of the 60-cycle charging current, and in a properly adjusted circuit they in no way interfere with the charging current. Where a rotary spark gap is used, it has the effect of still further increasing the frequency of the spark several hundred times a second. Since high-frequency current travels over the surface of a conductor, or along



How loading coil is connected and, at right, a view of the 36-in. high-frequency apparatus arranged for exhibition

the skin of a human being, it may be readily understood why a person may take a high-frequency discharge of several hundred thousand volts and suffer no ill effects.

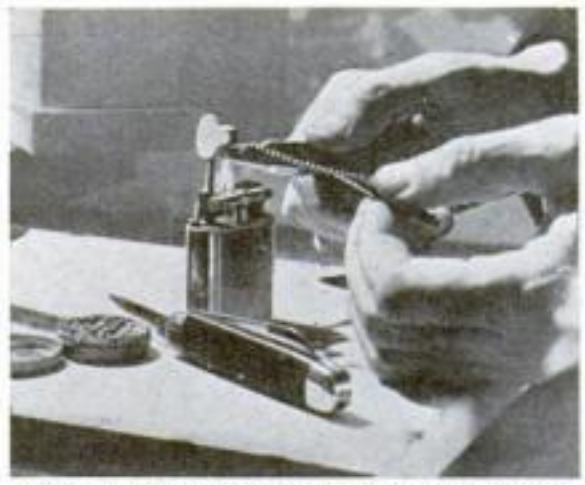
As the 12,000-volt high-frequency current flows through the primary winding of the high-frequency coil, a current is induced in the secondary coil, the terminal voltage of which depends upon the ratio of the secondary to the primary turns. The voltage induced in the secondary coil is proportional to the number of secondary turns, and at a point along the secondary even with the top of the primary coil the voltage is high enough to produce a spark several inches long. To avoid sparking between the coils at that point, the primary coil is tapered away from the secondary.

The importance of properly adjusting the high-frequency circuit cannot be too strongly emphasized. The author has seen high-frequency apparatus where merely adding a portion of a turn to the high-frequency coil primary changed the discharge from a weak, stringy spark to a mass of beautiful long streamers. For greater flexibility and as a means of adjusting the coil to its maximum output, it is suggested that an additional loading coil be inserted between the condenser lead and the primary coil. Six to ten turns of bare copper or brass wire wound on a cardboard or wood form 6 to 8 in. in diameter will be quite satisfactory. Any size wire larger than No. 10 will do, and it should be spaced so the connecting lead may be clipped to any turn.

If the stationary electrodes of the rotary spark gap are separated too far from the revolving studs, a spark will occur only in unison with the 60-cycle charging current, and this may be decidedly unpleasant to take through the body. The proper separation will depend upon the speed of the rotary part of the gap. It may usually be determined by the sound of the *(Continued on page 97)*

Night picture of the discharge as it plays freely around and through a common bottle

MODEL PARTS SOLDERED WITH LIGHTER FLAME



Using a cigarette lighter and paste solder to fasten links of ship-model anchor chains

DELICATE soldering operations such as are often required in model work may be done quickly and neatly with the aid of an ordinary pocket cigarette lighter and solder of the low-melting, paste type. Chain links and rings for anchor chains, for example, may be soldered in this way.

LOOSE SHAFT COUPLINGS REDUCED BY SHRINKING

How the coupling, after being heated, is set up so that little or no water will run inside

IN OVERHAULING shop, factory, or marine installations where shaft couplings are used, a machinist often comes across a coupling that is a few thousandths of an inch loose. Fitting a new key will only make matters worse, especially if the shaft turns at high speed, yet to bore out the coupling and make a bushing to be pressed on means much extra work. Shrinking the coupling will usually accomplish the same result. In fact, the writer has reduced steel couplings 6 in. or larger in size as much as 1/16 in. at one operation.

Heat the coupling to a dark cherry red in a slow fire. If it is more than 1/64 in. too large, heat it slightly longer, but take care not to "scale" it. Lay a piece of asbestos a little larger than the flange diameter on a faceplate or any flat surface. If the coupling is comparatively small, have ready another piece of sheet asbestos to fit on top; this can be weighed down with any stock casting of a size to serve as a cover. Also have a water hose handy.

Pick the coupling out of the fire, brush off any coal or dust on the flange, and lay it on the sheet asbestos. Place on top of it the small piece of asbestos and the weight. Then play a little water all around the outer surface, beginning at the top and going down. Take care that as little water as possible runs inside the coupling. If the coupling does not shrink sufficiently, the operation may be repeated.

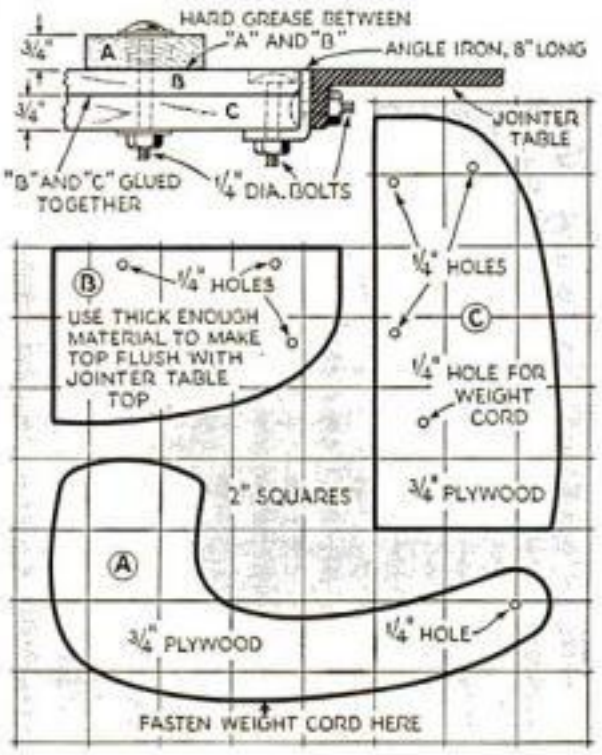
When reboring the coupling, take a light cut off the face of the flange as the heat may have warped it.—A. W. LORENZ.

GUARD EASILY ADDED TO UNPROTECTED JOINTER

The wooden guard covers the jointer cutter, swinging out only enough to let the work by

RATHER than risk one's fingers working with an old-fashioned or unguarded jointer, it is better to take an hour's time and make a wooden guard that will cover the part of the blade not in use. A simple way to do this is shown in the accompanying illustrations. Note that a length of sash cord with a weight on the end is used to supply the pressure necessary to keep the guard against the work at all times. This also holds the work against the guide, which in turn makes operating the jointer much easier as well as less dangerous.

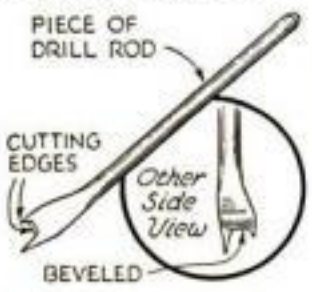
In the photograph, a brace will be noted on the piece *A*. This is not necessary, however, if plywood is used as suggested in the drawings.—J. P. KNIPP.



Patterns for cutting the three parts of the guard, and a view showing method of assembly

EXTRA LONG WOOD BITS MADE FROM DRILL ROD

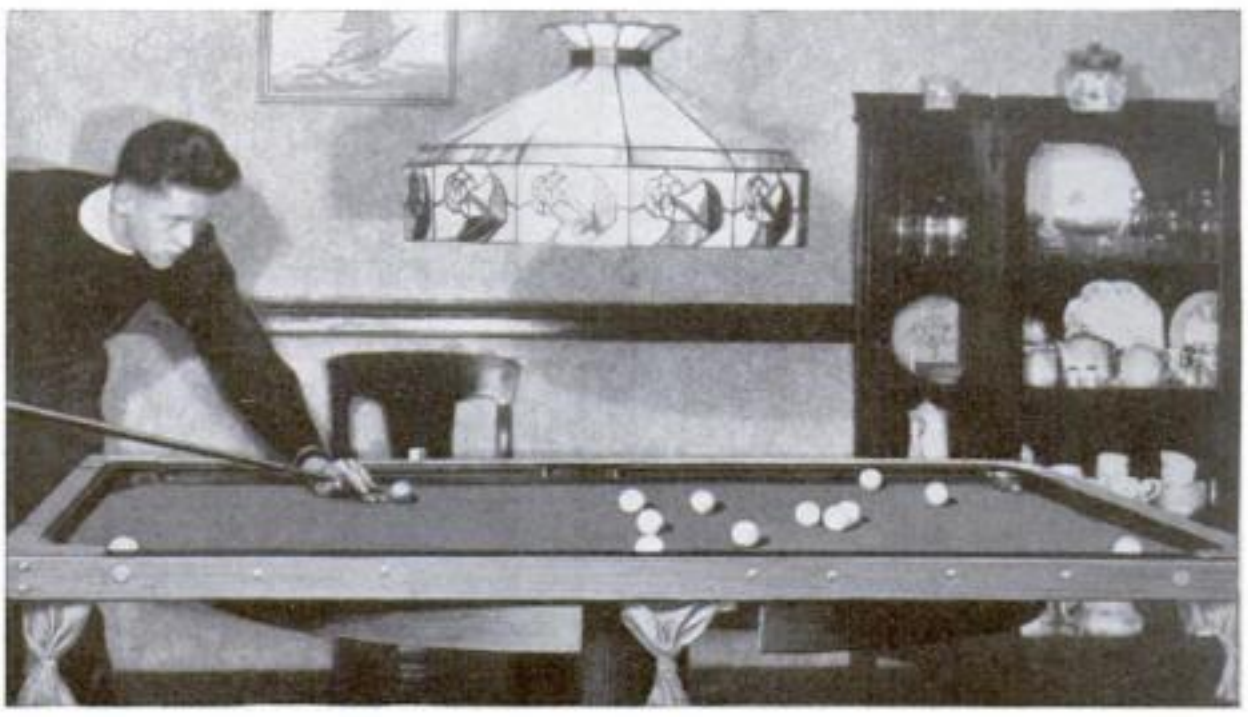
WHEN an especially long bit is required for boring wood, or a small bit of some unusual size, it can be made from a piece of drill rod as shown. I have made bits of this type as long as 18 in. for use where a shorter one would not serve the purpose. They are held in the chuck of a lathe. In making bits of this kind, the point should, of course, be in line with the center of the rod as indicated in the drawings, so that a true hole can be bored. —JAMES H. BEEBEE.

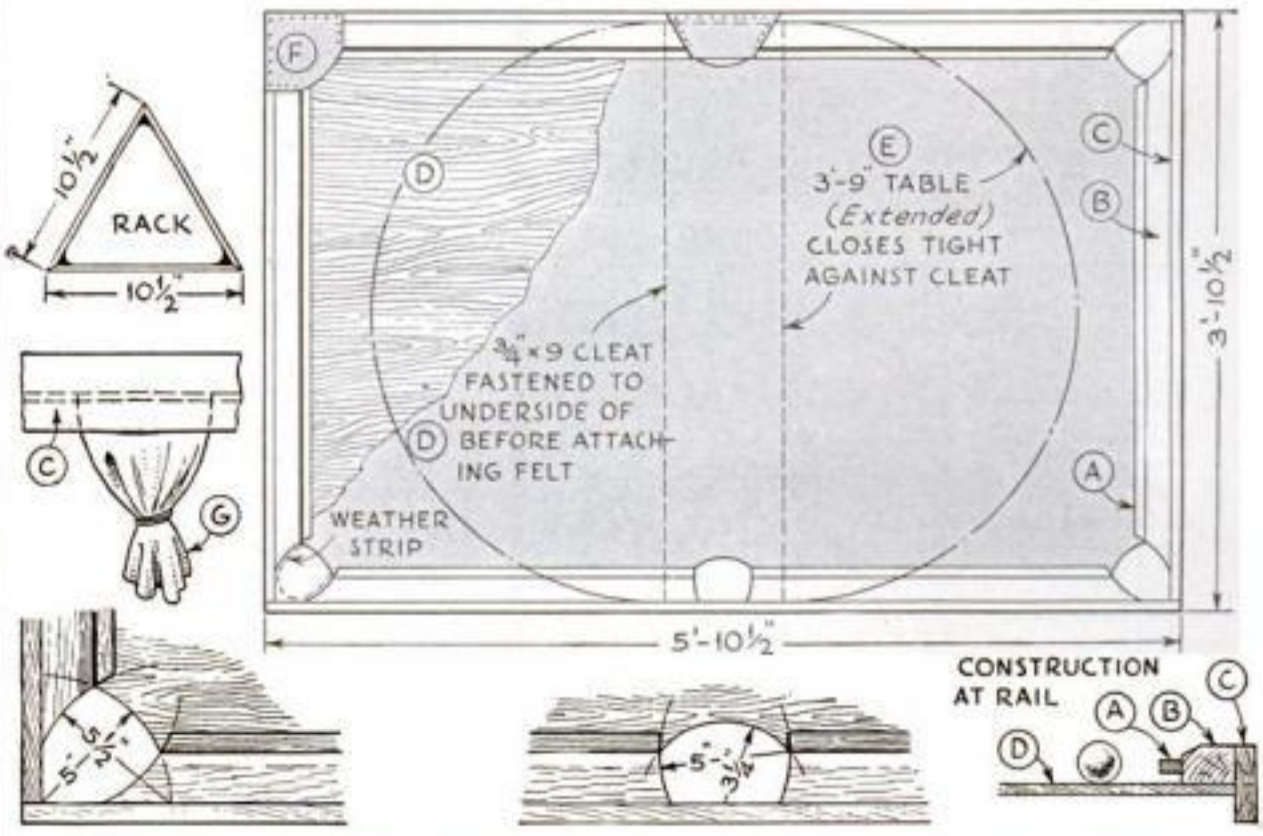


Improvised wood bit formed on end of rod

Golf-Ball Pool Table

Can be set up on any large dining-room table—Rubber cushions are not required





How the golf-ball pool table is constructed and used. It has a cleat on the underside that fits between the opened halves of an ordinary round dining-room table. The cushions marked *A* are of hardwood instead of rubber, and the playing surface is covered with an old blanket

A FAST and accurate game of pool can be played with golf balls on the homemade table top illustrated above. It is inexpensive and easy to construct, has no rubber cushions to deteriorate, and requires only an average size dining room or kitchen for space.

The original top, which has a playing surface 3 ft. 5 in. by 5 ft. 5 in., was built to suit a dining-room table 3 ft. 9 in. in diameter. If your table is a different size or shape the dimensions must be altered, but the same construction of rail and pocket can be followed.

The parts marked *A* are ½ by ¾-in. hardwood; *B*, 1½ by 2-in. pine; *C*, ¾ by 3-in. pine; and *D*, ⅜-in. plywood. The dining-room table is represented by a dot-and-dash line and marked *E*. The felt is indicated as *F*, and the felt pockets as *G*.

Fasten *A*, *B*, and *C* to the plywood first, mitering *A* and *B* at the corners and gluing and screwing all securely. Then to mark the pockets, either trace around a template made from sketches or lay them out with a compass directly on the wood. Saw down through *A*, *B*, and *D* to form holes for the pockets. The cushion at *A* should be of hardwood and not more than ¾ in. above the plywood.

The cleat underneath should be at least

¾ in. thick and 9 in. wide. It is attached with flathead screws, down through *D* and up through *B*.

An old blanket dyed green makes an excellent bed. Attach the cloth to *D* with either linoleum paste or automobile running-board cement. Be sure to roll out all wrinkles. Slash the cloth at the pockets and glue it up underneath. I used the same material for pockets, having them sewed up in the form of sleeves about 8 in. in diameter and 10 in. long. Tack one end under each hole, and tie the other end 2 in. from the bottom.

A piece of padded weather strip tacked in the pockets directly opposite *A* and pieces of green cloth tacked across the top of the pockets will kill all rebound of the balls at the pockets. Angle irons in the corners will help stiffen the table and make it more durable.

All exposed wood should be sanded and stained dark red. Add two coats of wax or varnish, and you have a pool table to be proud of.

At a sporting goods or chain store, you can buy practice golf balls, often for as little as ten cents each. Get sixteen of these and stain one black or red to be used as a cue ball.

An easy way to make a strong rack of ¼ by 1-in. hardwood is to build it around a triangle made of 1-in. wood, each side being 9½ in. long. Glue and brad the corners only, and when the glue is dry, cut away the centerpiece to leave the rack as shown in the drawing.

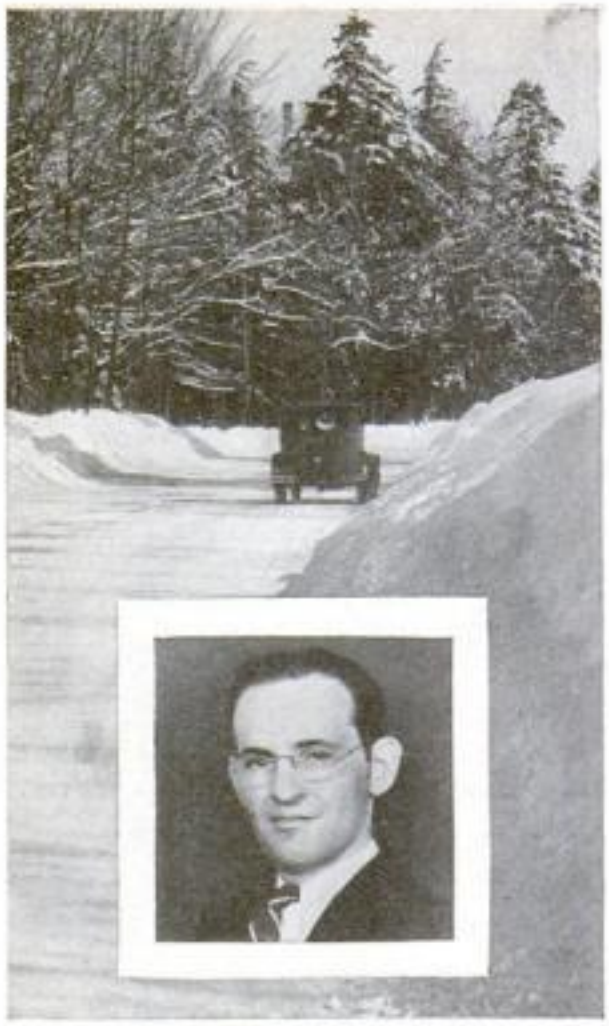
You will probably want three or four cues. Make these of any straight-grained hard wood 4 ft. long and tapering from 1¼ in. straight down to ½ in. at the tip. Sand these well, stain any dark color, and add leather tips, which you can buy for a few cents from any dealer handling pool supplies.—CHARLES H. MCINTOSH.

DRILL CASES MADE FROM OLD CARTRIDGE FUSES

A convenient case for holding a variety of small drills and bits can easily be made from a renewable cartridge fuse of the type having ends that screw on. All that is necessary is to remove the insides of the fuse and solder up the slot in the end of each screw cap.

In certain larger fuses where the slotted disk is loose, a new disk can be cut from copper or brass and soldered in place. When soldering the disks, it is advisable to fill the end with cotton waste or a rag so as to protect the threads, otherwise the solder may flow in and fill up some of the threads.—W. T. BAXTER.

Old cartridge fuses of the type having ends that screw on may be used for holding drills



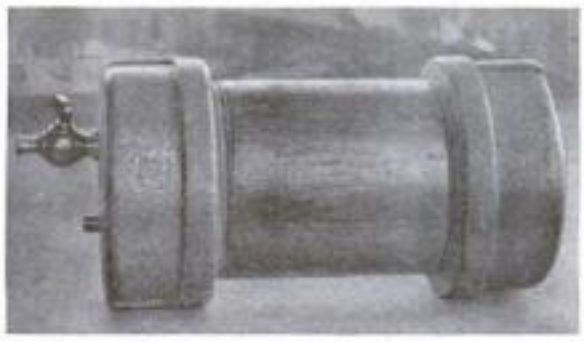
Snapshot of William H. Cadugan of Scranton, Pa.

AQUARIUM AERATOR USES AIR FROM GAS STATION

AQUARIUM air pumps are usually quite expensive and beyond the resources of most amateur mechanics to construct, but a simpler type of aerator may be easily made. Furthermore, it requires no expense for operation or upkeep.

Obtain a 10- or 12-in. length of 3-in. pipe (the longer the better) and two caps for the ends. Your local plumber can provide these at small cost. In one cap drill and tap a hole for a small air valve or stopcock such as found on old steam radiators—one that can be turned on and off by hand. Make sure that when the valve is in the "off" position, it is perfectly air-tight; it must not leak air under any circumstances.

About 1 in. from the first hole, drill and tap another hole for a valve removed from



The air is stored under 75 or 100 lb. pressure in a miniature tank made from 3-in. pipe

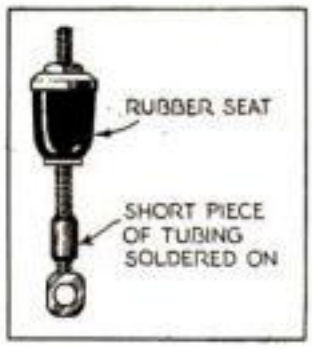
an old automobile inner tube. If no tap for this valve is available, a clearance hole may be drilled for it and the valve securely soldered into the cap. Let the top of the valve protrude about ¼ in. The tire valve should be far enough away from the stopcock to allow the fitting from an air hose, such as found at all gasoline filling stations, to be applied to it. The pipe caps are now securely threaded on the pipe, and the aerator is ready for filling.

At any gasoline filling station, fill the container with air to a pressure of 75 or 100 lb. Then, by running a rubber hose from the stopcock into the aquarium and opening the valve ever so slightly, a steady stream of air sufficient for even the largest tanks will flow for several hours. Used intermittently, an aerator of this size supplies a 10-gal. aquarium for about one week before requiring to be detached and refilled.

A glass tube drawn down to a fine opening and inserted in the end of the air hose in the aquarium discharges a stream of small bubbles and renders the device considerably more efficient.—W. J. KUTCHER.

BROKEN FAUCET PLUNGER REPAIRED WITH TUBING

WHEN the inner plunger or stem on a bathtub faucet broke recently, a new one could not be obtained at once. Lacking a set of dies, I nevertheless made a rapid emergency repair as follows:



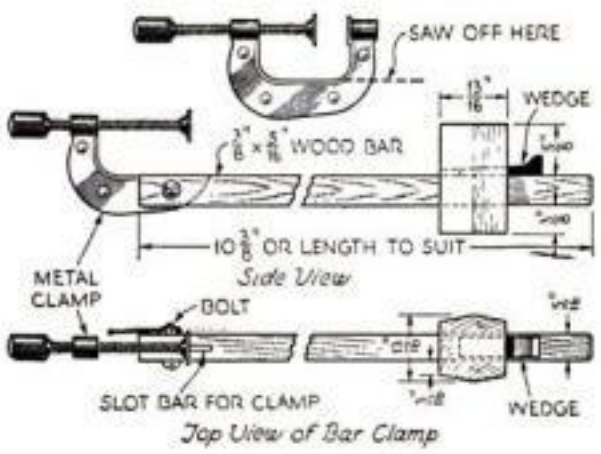
A short piece of tubing was expanded by driving a large spike through it. The ends of the broken plunger were then slipped into this and soldered in place. The repair was still doing duty when the new plunger arrived by mail several weeks later.—A. L. JACKSON.

MINIATURE BAR CLAMPS AID IN MODEL WORK

This model of a house is being glued with the aid of two small homemade bar clamps

MINIATURE bar clamps for gluing models and other light, delicate work are easily made as shown in the drawing below. The head of each bar is made from a ten-cent C-clamp of the pressed-steel type. All that is necessary is to cut off the fixed end of the C-clamp, drill a hole for a bolt, slot the wooden bar, and fasten the clamp in place. The two halves of the C-clamp flare out and give a bearing so that it won't turn outward when pressure is put on.

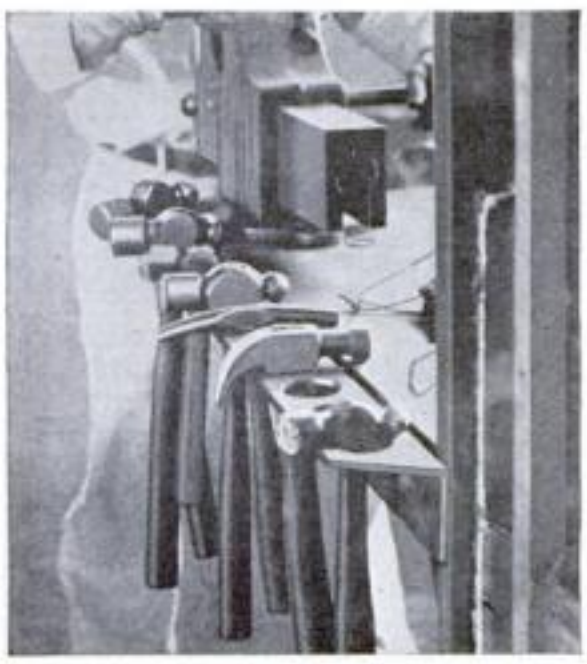
Innumerable uses will be found for a pair of these clamps.—T. B. O.



A pressed-steel C-clamp is fastened at one end, and a sliding block used at the other

HAMMERS KEPT HANDY IN ANGLE-IRON RACK

A 3 by 3-in. angle with holes of various sizes in one flange may be bolted to the edge of the workbench as shown for holding a variety of hammers, cold cuts, and other handled tools. They are thus kept out of the way and off the working surface of the bench, yet are easy to get at.—JOSEPH C. COYLE.



Strip of angle iron at end of bench with a number of holes for hammers and other tools

WHITTLED FIST FORMS NOVEL DOOR KNOCKER

THIS decorative wooden door knocker is carved or whittled in the shape of a conventionalized or simplified fist. All that is required is a piece of wood 1½ by 3 by 4½ in., a 1-in. butt hinge and screws, and a pair of the small, hardened steel caps or glides that are ordinarily used on chair feet.

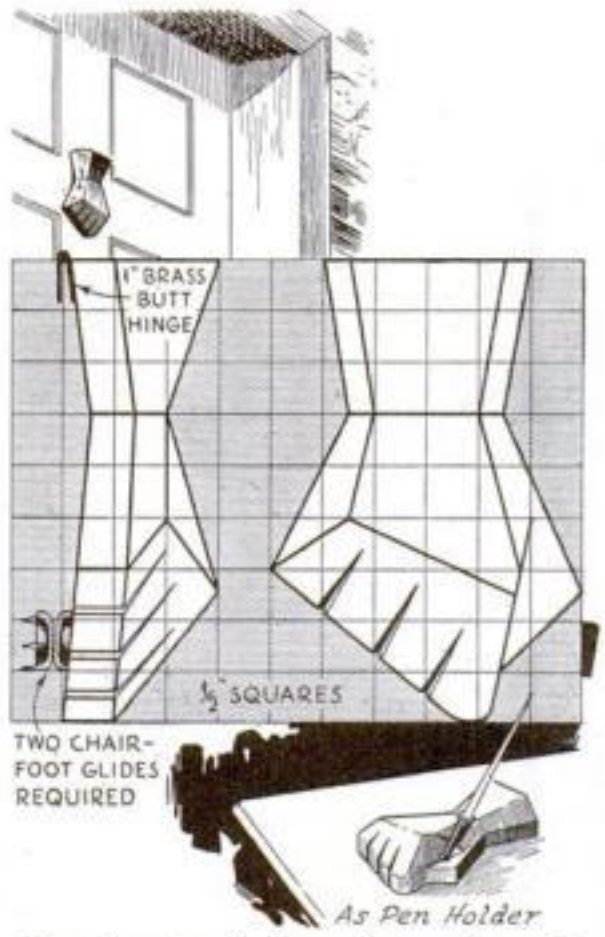
The block is laid out in ½-in. squares on one wide face, and the pattern of the hand is traced by copying square for square from the drawing. The hand shape is then sawed out. The back face is whittled or chiseled on a taper from both ends toward the wrist, so that the wrist is ¼ in. below the back surface, as indicated in the side view.

Conventionalized hand easily made from wood

The fist is formed by tapering from the knuckle line to the middle joints of the fingers until the lower edge is only ½ in. thick, and from the knuckle line back toward the wrist until wrist thickness is only ¾ in. The thumb is formed by cutting straight across at the edge of the index finger, leaving the thumb extending out to the right and only ½ in. thick. The sides of the wrist are then chamfered as indicated, and equally spaced notches cut in to indicate the fingers. The wood may be stained or left natural and finished with linseed oil, or it may be painted.

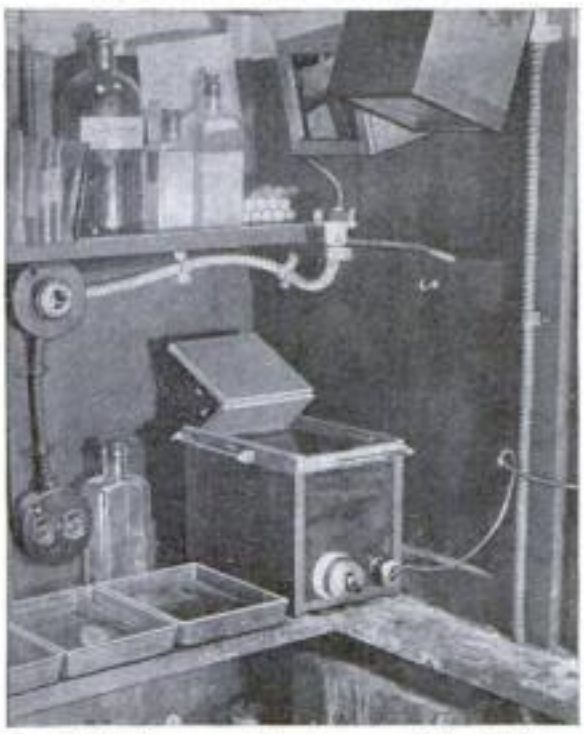
The butt hinge is put at the top of the cuff, and the glide is fastened at about the center of the back face of the hand. Screw the hand to the door; then put the other glide on the door so that they strike together when the hand is lifted and dropped.

A similar design may be used as a holder for a desk pen. In this case the socket for the pen is inserted in a hole drilled at an angle between thumb and forefinger, as indicated in the sketch, and the underside of the hand, instead of being hollowed out slightly, is left flat and covered with felt.—E. J. TANGERMAN.



Two views showing how to lay out the wood, and sketches of door knocker and pen holder

PRACTICAL DARKROOM BUILT IN CLOSET



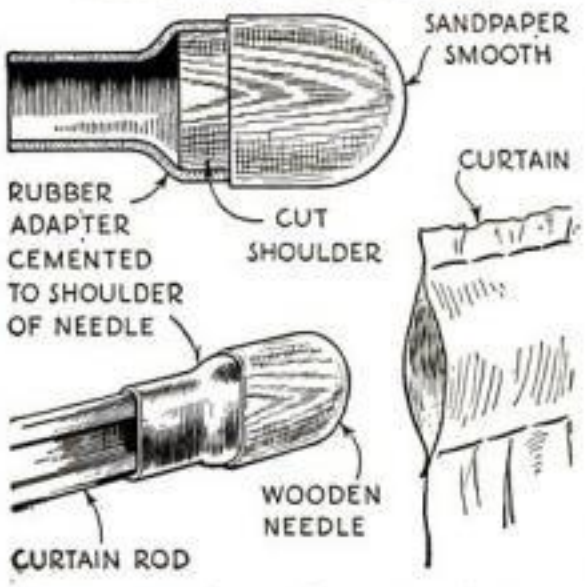
Small darkroom with printer and developing trays. The safe lights are at upper right

A CLOTHES closet with an available floor space of 4 by 4 ft. and only 7 ft high has housed the author's darkroom satisfactorily for more than three years. It is an example of what the amateur photographer can do if it happens that his cellar is too damp for a darkroom, the attic too hot, and the bathroom too difficult to make lightproof.

A bench 12 in. wide was installed 40 in. from the floor for the printer and the developer trays. A shelf was built under it to hold storage bottles for fresh water, stock hypo, and stock developer. A narrow shelf, 18 in. above the developing bench, was built for paper and chemicals.

The entire inside of the closet was painted flat black, and felt weather stripping was applied around the door to give light protection. To carry waste water away, a copper pipe was fished through the wall to the cellar. A small fan was placed near the ceiling to provide air circulation. Safe lights, made in wooden cases with an asbestos lining, were mounted on the wall at right. Negatives and prints are washed in the bathtub, and enlarging is done at night, with the outside room darkened.—RONALD L. IVES.

AN EASY WAY TO INSERT RODS IN CURTAINS



PLACING curtains or drapes on rods usually is a temper-trying ordeal because the corners and edges of the rods continually catch. This can be prevented by making a wooden "needle" or nose with a rubber adapter, as shown, to fit various curtain rods of different shapes.—LAURENCE N. OLSEN.

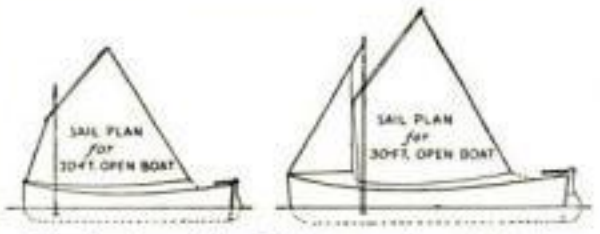
REALISTIC SMALL BOATS

(Continued from page 65)

next plank will come, and cut a plank to lie along the marks. You will notice that by cutting to a smooth curve that hits these lines, the planks will curve up at the ends as required. This second plank is glued to the first. Marks are then made for the next, and so on until all are on.

When you have the shape right for a plank on one side, cut another to go on the opposite side and fix that before proceeding to the next. If you are making several boats of the same shape, cut enough planks for all from the pattern you have made. I found that a cellulose cement was the best for this work because it dries so quickly, and one can hold the plank in position until set. Nip the ends of the planks in close with the thumb nail at the stem and stern and let them remain glued there until later, when they can be cut to shape with a razor blade. Let the top strake come a little above its marks. Shave or grind the keel to its proper depth.

Gently work the planking and backbone off the mold and put in the ribs. For these I cut long strips of cardboard about 1/32 in. wide,



Dipping lugsails of the type shown in these plans are regulation equipment for lifeboats

glued them on one side, and laid them in the boat from gunwale to gunwale not more than 3/16 in. apart. Towards the ends they have to be divided at the keel. To help the boat hold together, I always run some plastic material or thick glue along the inside of the stem and stern; quite a bit can be put in because it will be covered by the gangboards.

I made the gunwales (inside the boat) of 1/32-in. holly wood a full 1/16 in. deep. These should be sprung in nicely so as to give a good sheer line. They are glued to the frames, and the ends of the frames and edge of the upper plank can then be shaved level with them.

The gunwale (pronounced gun'el) is finished off with a strip of cardboard glued on top. Lay the boat keel up on a piece of cardboard, mark the outside curve, and from it mark the inside curve, making it the thickness of the plank, rib, and gunwale. Cut it to that shape.

At the thickness of the thwarts (seats) below the gunwales, glue other strips of wood about 1/32 in. square for them to lie on. These are the risings.

Along the center line in the bottom, a very thin strip of wood is glued for the keelson; and on each side are glued curved strips of cardboard for the bottom boards or footings. In the stern sheets is placed a little grating, also made of cardboard.

Paint up to the risings gray or other suitable color, except the grating, which should resemble teak.

The thwarts should be a bare 1/32 in. thick and 3/32 in. wide. Set them temporarily in position, being careful that they are of the right length to preserve the proper width of the boat. Now make the bow and stern gangboards (platforms), getting their shapes by trying out with slips of cardboard. Holly is a good wood for all this work. Glue everything in position and, if you wish, make three-cornered knees running from each thwart to the gunwale.

Adding a rubber at the lower edge of the top strake is an improvement. For it, glue on a very thin piece of braided cord or a slip of wood. The latter is better.

A board to sup- *(Continued on page 93)*

REALISTIC SMALL BOATS

(Continued from page 92)

port the mast and a step will be required, and a hook at either end for the tackles. The hooks should bolt under the keel, but this is difficult, so they are made of small pins with the ends bent up under the gangboards.

The whole boat may now be painted the required colors, but be very careful not to ruin it with gummy paint.

I made the navy whaleboat shown in a slightly different manner. I carved out a boat to the dimensions as given on the *Hartford* blue-prints, then slit it in half and gouged out each half as thin as possible. This can be done so thin that you can see large print through it. As these boats have a large stern locker, I left that part solid. I then planked each half, as before, but glued stiff writing-paper planks onto the shells. I then cut a keel, stem, and stern backbone of a width to extend the right amount and fill up all the space between the two halves. This can be found by laying one half on the material and marking from it.

The two halves are glued to this, and the ribs and other interior fittings applied. I made the top strakes thicker by using cardboard, and gave the boat cap gunwales only.

THIS method sounds a lot easier than the other, but by the time one has gouged out the halves and shaped the planks, there is not much difference in time or care, and, of course, the boat is a shade thicker and does not show the planks inside.

The cutter I made in two halves like the whaleboat, but instead of putting on planks, cut them into the wood. To do this, carefully mark each plank. With a knife, make a shallow cut along each line, and use a chisel to cut away a shaving to each line from below, finishing up with a little file. This plan is easier, but never quite so neat.

For reference, here are the actual measurements of some of the principal parts of a merchant ship's 30-ft. boat: Keel, 6 by 36 in.; planks, ⅝ by 5½ in. with ⅞-in. landing or overlap; sheer strake, ¾-in. hardwood; timbers (ribs), 1 by 1½ in. set 6 in. apart; thwarts, 1¾ by 9 in.; rudder, 1¼ by 19 in.; mast, 19 ft. long. A 26-ft. boat would have 15 strakes.

There are of course, other ways of making boats. One can carve them from the solid, hollowing them out and cutting away to leave the stem, stern, and keel. This will serve for very small boats, but for anything over about 2 in. it really gives more trouble than the other methods.

Excellent boats can be made on a mold with strips of thin paper soaked in casein glue and sandpapered. This is the best plan for carvel-built boats, but they can be planked as described here for the whaleboat.

Boats can also be made from plastic material, using an outside and inside mold. These boats are difficult to get smooth and are fragile and liable to warp.

The methods described are all for lap-straked or clinker-built boats. Smooth sided, carvel-built boats or steel boats are much easier because one does not have to show planking. The carved wood and glue-soaked paper methods are best for them.

A well-built boat rates some equipment. I suggest at least a full set of oars (blades always forward), a rudder, and a painter (bow cord). To these, if scale permits, should be added a mast and sail (the sail will be made up on its boom and have a painted canvas cover), boathooks, tiller, rowlocks or thole pins, water breakers, and other equipment, and on the outside of lifeboats, the life lines or grab lines. All equipment must be lashed to the boat.

A ship's boat should have the name on each bow and the name and port of registry on the stern.

Old Bill SAYS:

WHEN chatter occurs on lathe or milling machine, try raising the feed, not lowering it. The secret is to keep the tool against the job by placing a slight "spring" in tool or arbor.

• • •

Diagnose symptoms properly. Too much surface speed burns the cutting edge of tool. Too much feed breaks down the cutting edge.

• • •

In milling reamer flutes, avoid spacing flutes evenly. Evenly spaced cutting edges in reamers cause them to "track," and they won't function properly.

• • •

If smooth, round holes are desired, use carbon steel, rose-type reamers without peripheral clearance, and preferably reamers with a left-hand or negative spiral flute.

• • •

When using a two-flute shear-cut or gun tap in a blind hole, drill the hole exceptionally deep to provide clearance for chips, which are pushed forward into the bottom of the hole by this type of tap.

• • •

Before mounting a milling cutter on an arbor, be sure that the sides of the arbor collars are parallel with each other and free from dirt and burrs.

• • •

A little camphor placed in the tool box will help keep tools from rusting.

ADHESIVE TAPE MAKES V-BELT LAST LONGER

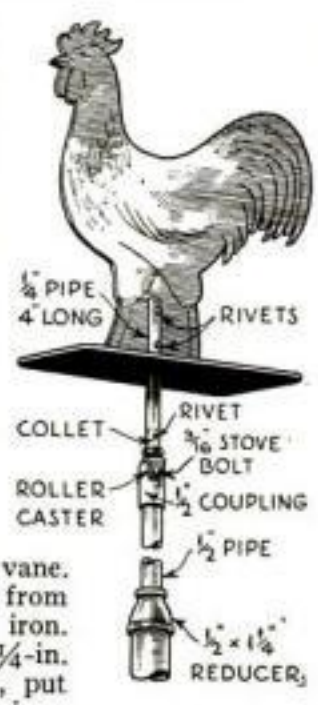
IF A SMALL V-belt becomes worn and ragged from long use, its life can be prolonged somewhat by refacing the inner surface with a strip of ordinary surgical adhesive tape. In order to apply the tape it is necessary to bend the belt as illustrated. Be sure to make a smooth joint where the ends of the tape meet. After returning the belt to the machine, turn the latter by hand several times so that the tape will seat itself correctly.—C. L.

POSTER LETTERING DONE WITH CORNSTALK PEN

A PIECE of ordinary cornstalk makes a satisfactory lettering pen for poster work. Select a piece of cornstalk having a diameter equal to the letter width desired. Pare the end to a chisel shape with a sharp penknife, and square off the writing edge.

To use the pen, charge the end with ink and hold it like a regular broad-point lettering pen.—GEORGE A. SMITH.

WEATHER-VANE BEARING MADE FROM CASTER



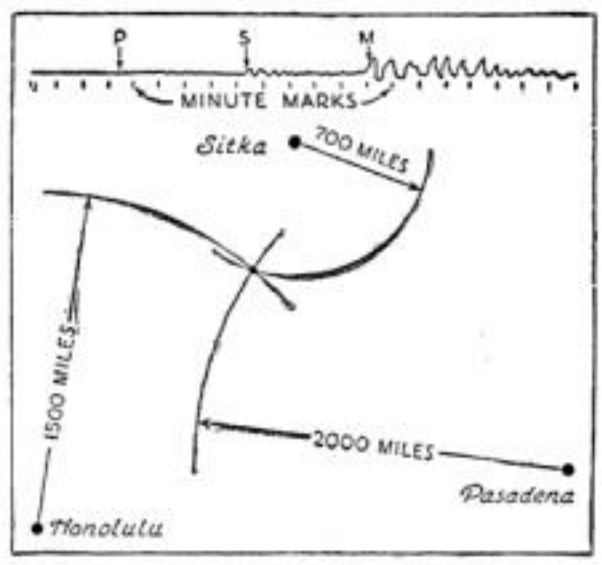
TO MAKE an efficient weather-vane bearing without a lot of work, I used a roller-bearing caster that came from an office chair. After removing the wheel, I slipped the jaws over a ½-in. pipe coupling, and drilled and tapped for 3/16-in. stove bolts where the holes of the jaws came, to secure the bearing to the coupling. This left the tailpiece upright and ready to receive the vane.

The vane was made from 18-gauge galvanized iron. I took a piece of ¼-in. iron pipe 4 in. long, put two hack-saw blades in a frame and sawed a slot lengthwise of the pipe for 2 in., and pressed this on the vane, riveting it securely. A plate with a hole in it was slipped over the pipe, as shown, and soldered to the bottom of the rooster. This plate and the metal between the legs were painted leaf green, and the legs were painted yellow. In this way the necessity of making separate legs was avoided, yet from the ground the appearance is quite natural.

The collet or socket of the caster, which had been originally pressed into the leg of the chair, just fitted the ¼-in. pipe, so all I had to do was to press this into the pipe and put the tailpiece into the socket, after wrapping a piece of tin around the tailpiece to make it fit. I then drilled through the pipe and tailpiece to receive a finishing nail, which I used for a rivet. I oiled the roller with transmission grease. The vane works perfectly in the lightest breeze.—N. F. POWERS.

SEISMOGRAPH RECORDS DISTANT QUAKES

(Continued from page 67)



Three-station method of computing location of an earthquake. Each station calculates the distance by the variation of the wave time; then scale radii are used to strike arcs, all of which intersect at the epicenter

blocks, which in turn are held upright by a base board. If the drum is rotated, it will be drawn endwise corresponding to the lead of the screw, and thus a continuous line is traced by the stylus. Driven one revolution per hour by a small electric clock, the paper will last several days without changing.

Block up the clock until central with the tubing. Remove the hands, and attach a radio universal joint to the hour-hand shaft. To the other side secure a steel rod ⅛ in. square, having its other end thrust through the shaft washer, thus providing a drive for the drum, no matter what its endwise position.

THE drum assembly must be blocked up to such a height that the drum is a little below the level of the extension arm tip.

Friction between the stylus and the paper on the drum must be reduced to a minimum, and this is accomplished by the use of a counterbalanced needle. Cut a match stick ¾ in. long, cut two small sewing needles in half, and put the pointed halves in the ends of the stick. Run another small needle through the center of the match so that a cross will be formed. It is the point of this needle that traces the line on the smoked paper.

For pivot bearings, make a small hole in each side of the Y with an ice pick, and screw in two clock balance-wheel cups. Mount the stylus pivot between them. After a few trials the tracing needle can be balanced so that the point will rest very lightly on the paper.

Highly glazed paper, such as enamel-finished book paper, should be used for the record, since its smooth surface will hinder the movement of the needle but little. Almost every printing shop carries some in stock. Use a kerosene lamp to smoke the paper, turning the flame high and holding the paper above it until a black deposit of soot has been deposited.

Sometime during the recording, mark the position of the stylus at 12 m., so that time can be reckoned from it. After recording, fix the sheet by spraying it with a solution of six parts alcohol to one of white shellac, and use it as a negative, if desired, for printing the permanent record on photographic paper.

The seismograph, of course, will register only shocks that vibrate somewhat out of the plane of the post and arm. To receive quakes from all directions, two instruments should be built and set up at right angles to each other.

When there is no disturbance, the pendulum will remain stationary and the needle will trace a straight line on the smoked paper as it moves beneath it; but when waves from a distant quake pass beneath, the needle will swing from side to side, sometimes less than ⅛ in., sometimes 1 or 2 in. Large or small, each line will create a desire to learn more about the science of seismology.

HAVING obtained a record, you will want to know the distance and location of the earthquake. The distance can be estimated fairly accurately. Avoiding technicalities, it may be said that three main waves emanate from the usual shock. The first, or primary (*P*) wave travels fastest. A slower secondary wave (*S*) comes a little later, registering on the paper, and later still a third, or main (*M*) wave. They start together, and diverge more and more as they travel from the source, and their rate of travel has been measured. Thus charts have been prepared that show from the time-separation of the recorded waves the distance to epicenter, or the area of ground immediately above the disturbance.

The location of a quake is learned by obtaining a card from the U. S. Coast and Geodetic Survey giving the data, or it can be computed from the records, as illustrated in the diagram.

PHOTO COLORS DYE WOOD FOR SPECIAL INLAYS

WHEN a rare wood of some special color is required for inlay purposes, but cannot readily be obtained without considerable trouble and delay, white woods of a similar grain structure can be easily dyed to resemble it reasonably well.

As a source of dye, the writer has often made use of the transparent water-color stamps sold in booklet form for coloring photographic prints. These booklets are inexpensive, contain twelve different colors, and can be bought at any photo supply house. Dissolve portions of the dye-coated sheets in alcohol to match the color desired. Immerse the wood in the dye solution for a length of time depending upon the penetration desired. The wood when dried is ready to use.

Novel effects may be produced in some woods by incomplete dyeing. When the veneer is dried and sanded down, beautiful striations of color are formed.—W. K.

MORE *Marionettes* COMING!

Many requests have been received for more articles on puppets since the publication of "Practical Marionettes Made from Old Inner Tubes" by Mrs. Florence C. Drake (P. S. M., Sept. '35, p. 58). We are glad you enjoyed that article and appreciate the suggestions you have made for topics to be covered in future articles. A series is now being prepared by Mrs. Drake. It will contain a large variety of simple ways to make marionette heads and bodies, animal puppets, and stages, The first of these articles will appear in the December issue, Watch for it!

HIGH-FREQUENCY STUNTS

(Continued from page 83)

spark. When a pure musical note is given off by the discharge across the gap, the adjustment may be considered correct. The maximum separation between the gap elements should not in any case exceed 1/16 in.

When operating high-frequency apparatus for the first time, especially in broad daylight, the experimenter is apt to be somewhat disappointed with the results. Only the strongest sparks will be visible in a bright light, and the beautiful brush discharge will be completely lost. Some views of spectacular night displays are shown. Of particular interest is the 6-ft. halo produced by the revolving wire described in the May issue.

If a small branch of a shrub or tree is fastened to the discharge rod of the coil, it will wilt and collapse almost immediately after the current is turned on. If the discharge is continued, the branch will burst into flames within a few seconds. If a dry, well-seasoned board is placed against the discharge rod, the spark will branch out and slowly creep to the top and sides of the board. At night the spectacle appears like a luminous tree slowly taking shape before the spectator's eyes.

Jacob's ladder produced with the high-voltage transformer

A stunt that never fails to mystify the layman is the lighting of a lamp with the current flowing through the lamp into the body. This may be performed by holding a lamp with attached wires and socket between the experimenter and the discharge spark, or by placing the lamp between two persons, one of whom is taking the discharge through a metal rod.

A neon-gas tube will light up weirdly if held within several feet of the spark. Outlines of figures and letters, if formed from a continuous piece of wire and suspended in the air with string, will glow with a strange blue light when the end of the wire is connected to the discharge rod.

Another interesting experiment may be performed by lighting a torch with the spark. The torch may be shaped from a piece of wood, one end of which is hollowed out to hold the burning material. A bare wire should extend from the hollowed end to the part that is held in the hand. If the hollowed end is filled with cotton waste or bits of cloth and brought near the spark, it will immediately burst into flame. The effect may be enhanced by previously saturating the waste or cloth with kerosene.

Ordinary insulators become excellent conductors for the high-frequency discharge. If a glass bottle is placed over the discharge rod, the sparks appear to meet little or no resistance in passing through the glass.

Some interesting stunts may be performed with only part of the apparatus. If the high-frequency coil is removed from the circuit and a coil of insulated wire connected in place of the high-frequency coil primary, an interesting demonstration of electromagnetic induction may be given. A second coil is made, to which is connected a socket or receptacle. The diameter of the coils may be any size that will hold its shape, and each coil may consist of from four to ten turns. If a lamp is placed in the socket and the lamp coil brought near the stationary coil, the lamp will light brilliantly when the current is turned on. If the lamp coil is moved back and forth before *(Continued on page 98)*

HIGH-FREQUENCY STUNTS

(Continued from page 97)

the stationary coil, the extent of the magnetic field may be readily observed. Since the action of the coils is similar to a transformer, the experimenter may vary the number of turns in each coil and note the various distances at which it is possible to light the lamp. In this experiment all connections remain the same as when using the apparatus for a high-frequency demonstration except that the two leads that formerly went to the primary of the high-frequency coil are connected to the ends of the stationary coil.

By attaching two bare wires to the terminal posts of the high-voltage transformer, the novel effect of a Jacob's ladder may be produced. The wires are arranged so that they come within ¼ in. of each other at one point, then slant upward and away from each other at an angle of about 45 deg. to a height of about 10 in. from the point of closest separation. When current is applied to the primary of the transformer, an arc will form across the points of least separation, and will then climb upward until it reaches a gap of several inches, where it is extinguished, only to be followed by a series of arcs as long as the current is on.

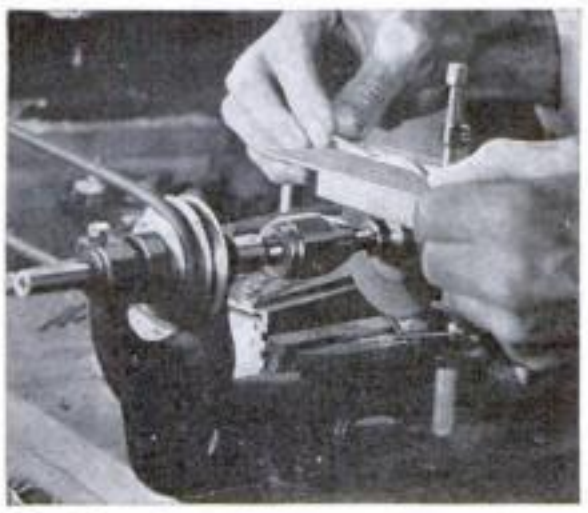
Although the discharge from a high-frequency coil may be taken with no ill effects, the spark should not be allowed to play on the bare skin, otherwise a painful burn may result. If the spark is taken through a metal rod held in the hand, the possibility of burns is eliminated. Caution should be exercised when working around the high-voltage transformer circuit, or when performing experiments requiring the transformer alone.

GUIDE FOR RESAWING A BOARD BY HAND

A groove cut around all four edges on a circular saw serves as a guide for the hand saw

A BOARD can be resawed by hand into thinner pieces when necessary by the method illustrated above. To guide the saw, it is necessary merely to make a saw cut all around the edge on a bench circular saw, setting the gage so that the cut comes exactly in the center of the edge. This cut serves as a guide to keep the hand ripsaw straight. A small piece of wood or metal the thickness of the saw kerf is put in the cut at the point where the board is clamped in the vise to fill the groove.—ROBERT PUTZER.

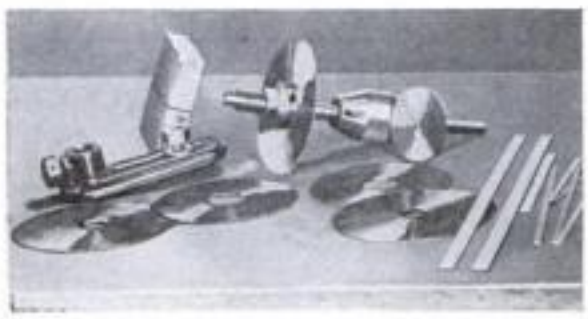
HOW TO SAW STRIPS FOR INLAY AND MODEL WORK

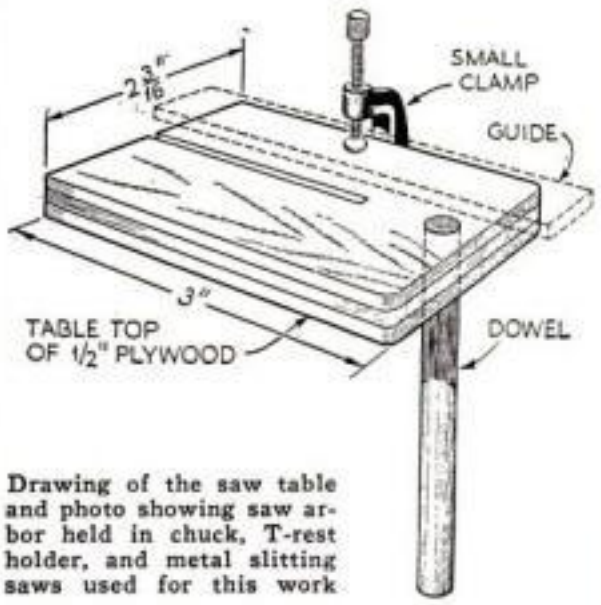


Used in a lathe, this homemade attachment saws veneer accurately into narrow strips

A SMALL lathe can be easily equipped with a miniature saw table for ripping veneers into very narrow strips for inlaying or model work. A piece of ½-in. plywood forms the top for table, and a piece of dowel is glued into it for the support. The dowel stick should be of such diameter that it will fit the T-rest holder of the lathe. A saw cut is made in the back edge as shown. A strip of wood held to the top of the table by a small clamp acts as a guide.

The photographs show 2-in. diameter metal slitting saws. These are placed on an arbor, and the arbor in turn is held in the lathe chuck.—T. B. O.





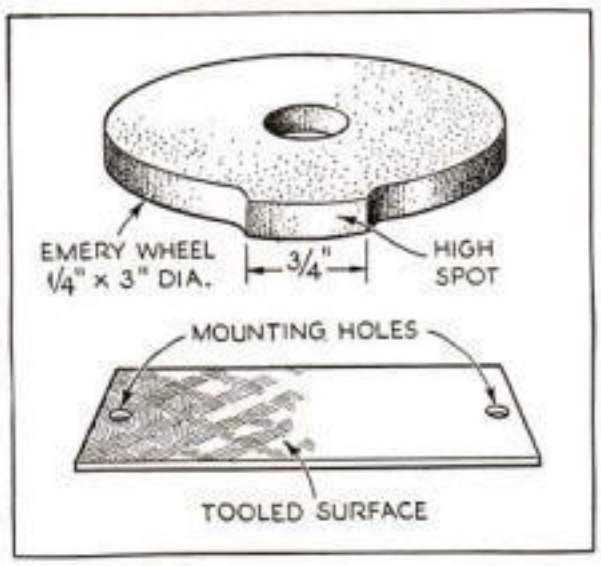
Drawing of the saw table and photo showing saw arbor held in chuck, T-rest holder, and metal slitting saws used for this work

SODA-STRAW PIPETTES

For the microscopist who does any work with protozoans or bacteria, one of the most irksome duties connected with his hobby is that of washing glassware, particularly pipettes. In addition, they are constantly being broken. These difficulties may be done away with by using, instead of lengths of glass tubing, cellulose soda straws. The cost is trivial and, after having been used once, they may be thrown away. Two or three should be kept on the instrument table; the remaining supply may be stored in a large, tightly capped bottle.—Richard H. Smith.

HAND-SCRAPED SURFACE IMITATED BY GRINDING

A TOOLED surface with a finish that resembles hand scraping may be ground on an ordinary surface grinder. The periphery of a ¼ by 3 in. fine-grained emery wheel is cut down about ⅛ in. as shown except for one high spot about ¾ in. long. The work is mounted on the table of the surface grinder and fed rapidly across under the wheel, and

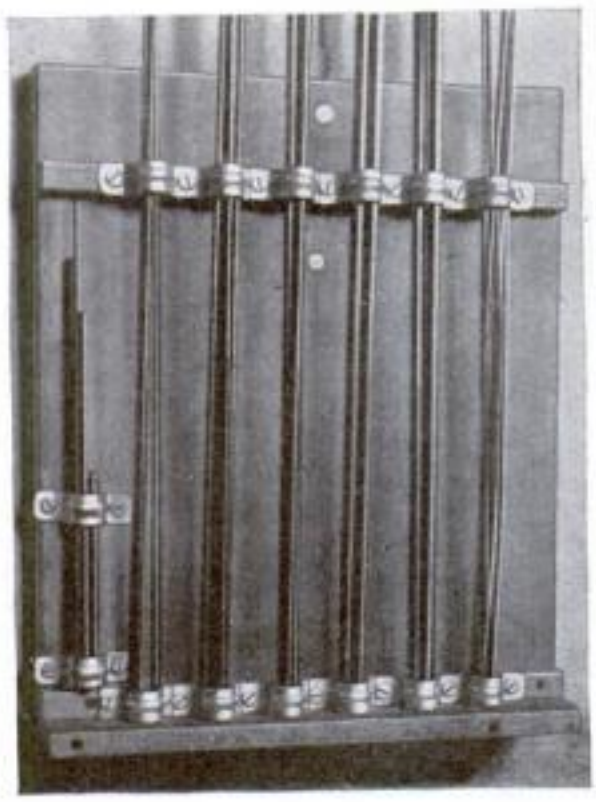


An appearance like expensive hand scraping is given by using a wheel cut down as shown

the high spot on the wheel leaves a series of ground patches. The wheel should make a light cut; usually .001 or .002 in. is deep enough. The table is then moved over the thickness of the wheel and another row marked on the surface. The whole surface is gone over in this way. Next, the work is rotated 45 deg., and the marks put on at this angle. The work is gone over four times, being turned 45 deg. each time.

If a ¼-in. wheel is used, the patches should be about ⅛ in. wide and from ⅛ to 3/16 in. apart for the best appearance. Any material may be surfaced in this way.—P. A. E.

CONDUIT STRAPS FORM RACK FOR DRILL ROD



AN INEXPENSIVE and serviceable rack for drill rod and similar stock may be made as shown above from conduit straps. To save space, the ends of the straps are overlapped and held with screws. Two straps fastened about 3-in. apart will hold short ends of stock. —DANIEL REYNOLDS.

MICROSCOPIC MARVELS IN YOUR GARDEN

(Continued from page 45)

medullary rays, fine radiating lines formed by layers of tissue between the fibrovascular bundles, are present. It is easy to distinguish between the bark and the woody growth inside the cambium layer.

The center of the section contains the delicate pith cells. Drop a weak solution of iodine on a cross section of such a stem (winter twig) and a blue color will appear in various parts, indicating the presence of starch. The pith, particularly, is used as a reservoir for the storage of starch as winter food. The iodine test also will show starch in the bark and medullary rays. The colored pattern formed by the test frequently is very beautiful under the microscope.

AS THE stem grows older, the chlorenchyma or former green part of the stem loses its chlorophyll and becomes a part of the bark. The epidermis and collenchyma have changed into a waterproof sheath of cork. Inside the cambium is the xylem, containing the ducts for carrying water, while outside is the phloëm, with the perforated sieve tubes.

As the stem matures still further, the cambium produces new wood inside and new bark outside. The wood increases in quantity while the bark, by weathering and peeling, remains fairly constant in thickness.

The alternate rapid growth of cells in the summer and the complete or virtual cessation of growth in winter causes the appearance of annual rings—bands or sheaths of woody cells which are large towards the center and small towards the outside. By counting the annual rings, the age of the stem can be determined.

While stem sections in their natural state are beautiful objects for the microscope, their beauty can be increased greatly by the application of stains. Such stains, because of their selective action, will also bring out the various cell groups more plainly. Iodine, mercurochrome, eosin, methylene blue, and haematoxylin are but a few of the staining materials you can employ. It is fun to experiment with various combinations.

You will discover, before you have succeeded in slicing many plant stems with a razor blade and a piece of cork or wood as a cutting block, that soft stems have a habit of crushing or that the cell formation is disturbed by the pressure of the blade. Often a satisfactory job of making either cross or longitudinal sections can be done with the aid of elder pith.

Simply split a piece of pith in two, cut a groove to receive the stem, then put the halves together again so that they will brace the stem as it is being cut. You can buy dry pith or get it from elder stocks. You might try freezing the stem, if it is very soft, in a mechanical refrigerator or by immersing it in a mixture of cracked ice and salt. Do not freeze it too solidly.

LABORATORY methods of making stem sections call for dehydrating in alcohol, clearing in xylol, infiltrating with and embedding in paraffin, and slicing with a microtome. The slices are cemented to slides, and paraffin dissolved away, the specimens stained, dried, and mounted in balsam.

If you want to make permanent slides of some of your stem sections, stain them, pass them successively through two or three glycerin baths of different degrees of dilution with water, and finally through pure glycerin, which is used as the mounting medium. Seal the edges of the cover glass with gold size. This method, while not as permanent as the use of Canada balsam, does away with the somewhat involved system of dehydration with alcohol.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

FIRST OF THE NEW $5 CONTEST WINNERS

Three prize winning letters in POPULAR SCIENCE MONTHLY'S new Secrets of Success contest—*"What Home Study Has Meant to Me"*—are printed below. Read these stories carefully because your own career may be just as interesting and inspiring to other readers. If you think so, put it down on paper and send it in. We will pay $5 for every letter we publish.

Contest Rules

Only letters from bonafide home study school students will be considered and these must contain the name of the school and the name of the company, or companies, for whom you have worked since graduation. (Names, however, will be deleted from the letters when published.) We also want to know the kind of course you took and the type of position you have held. Your own identity will be kept anonymous, if desired.

We are interested in facts, not literary ability, but please write clearly, completely, and keep your letter within 500 words. We are not looking for "get-rich-quick" stories or freak adventures, and authors must be prepared to substantiate the truth of the statements. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless sufficient postage is provided for this purpose. Address your contribution to Success Story Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

HEADS HIS OWN BUSINESS

After my father's death, I had to drop out of college and become the head of the family.

I couldn't afford to take a correspondence school course in the regular way but I did buy a course in show card writing and designing from a fellow (who was through with it) on the basis of paying for it out of earnings.

After several months of earnest study and practice I got to selling some of my work; then worked part time in a large show card and design shop which got me into the largest stationery and printing establishment in Seattle, Washington, because I could write show cards, dress show windows and do designing of various sorts.

This also made possible a year in night school, and while I later went into specialty selling and advertising for a large office equipment company, the hankering for lettering and design never left me and eventually I gave up a job as director of education and advertising with this company in 1925 to start my own business which I still operate.

Secrets of Success

We started out to give sign manufacture the same sort of scientific background which applies to other forms of publicity but we are called upon to do all kinds of unusual things dealing with design and manufacture. Our market is from coast to coast, but centers east of Ohio. We employ up to fifteen people and, strange as it seems, there isn't a "brush man" in the lot.

All of our processes are mechanical; most of them patented or proprietary. Our plant occupies two floors of some 6400 square feet of space and our inventories are more than $20,000. Our most recent commission of size was the design and construction of the Ohio State Exhibit at A Century of Progress.

The whole thing goes back to that correspondence course and the long nights I put in with it. I still have—and occasionally use—that original text book. That course had more to do with my destiny than three years of college, although both have been essential. It may be worth while to mention, too, that some of the subjects I studied in college and which then seemed utterly worthless, have proved to be very "every-day-valuable" in the work I shall doubtless follow all my life.—*E. M. H., Marietta, Ohio.*

HE WASN'T AFRAID TO WORK

In 1919, I came home from service with the A.E.F. to find that my school board employers had forgotten to hold my place for me. It was up to me to find a job or make one. During my period of war service I had thought at times of new fields of vocational activity upon my return (?) and had about made up my mind to try traffic management.

Almost the first expense after my arrival home in Chicago was to make a down payment on the excellent course in traffic management with ————. Good fortune seemed to shine upon my efforts at once. Approaching a railroad company for employment, a kindly official directed me to the Central Freight Association.

Clerical assistants were in demand as the revision of the Consolidated Freight Classification was under way. When the question of my actual experience was raised, I quieted the objection by the simple declaration that my professor in traffic management at ———— would be glad to recommend me. I was told to report for work the next day and that was the end of the "experience" objection.

During the following year, I labored by day upon the actual problems of traffic management and utilized some portion of most every evening upon the theory of the work with the ———— home course. I had been contacting different organizations in the meantime as the C.F.A. was about to be discontinued after the return of private operation.

One afternoon I was surprised to have a well-known official from the ———— Line stop at my desk and inform me that he was pleased with the recommendation he had received from my employers and got their starts by studying International Correspondence Schools Courses in their spare time. This is also true of leaders in a wide range of professions.

Our Electrical Engineering Course, as is true of the other 300 courses taught by these Schools successfully for over forty years, was prepared by outstanding authorities on that subject—and is under constant revision. The list of subjects below indicates the comprehensive service of this institution—a service that has been utilized by 4,000,000 ambitious men!

Understand, we do not claim I. C. S. training is a complete substitute for a college career. Many college graduates, however, have found in it the additional help they needed to attain certain objectives.

But we do claim that, in technical knowledge on a given subject made available, I. C. S. is the *equivalent* of college training. And the comparison is made with colleges of the highest rank.

You are standing on the threshold of a new era in this nation's economic and social life. Today, more than ever before, training is an essential to success. If you make the most of your talents and your opportunities, great things are in store for you. In your present situation, I. C. S. training is a real opportunity for you. Talk the matter over with your father and mother. The cost of an I. C. S. course is reasonable.

Cordially,

Ruth E. Reed

PRESIDENT

Dear Robert

Recently we have received many letters outlining problems similar to the one you now face.

You had planned on stepping from high school into college. And your parents had planned on it too. But the economic upheaval of the past few years has played havoc with countless well-laid plans—and family budgets.

It's tragic in a way, but life is an experience of constant changes. In the final analysis we are responsible for our own defeats—and our own victories. *No man is ever licked who is still willing to fight.* And with hope of a college career gone, you are still eager to fight for realization of your life's dream. You have a fine spirit.

You want to be an electrical engineer. You had planned on studying this subject at college. *All right, you CAN be an electrical engineer.*

Directed home study is the answer to your problem. Maybe you are fortunate and have a job. The answer to your dream lies in the utilization of your spare time. Many of the world's electrical engineers

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☐ Structural Engineer	☐ Patternmaker ☐ Boilermaker	☐ Automobile Mechanic	☐ Chemistry ☐ Pharmacy
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Secrets of Success

that an opening was available with the ——— tariff bureau if I wished to move in. An increase went along with the change, so the following Monday I was under the direction of a new employer.

A few months of interesting work passed by with the ———. Then a telephone call invited me for an interview with the chief clerk of the auditing department of the ——— Railroad. The interview terminated in about five minutes when the question of actual experience seemed to stop my prospective employer. I put on my best smile, stuck out my hand and said, "Thanks just the same. I stay where I am and keep plugging along with my ——— course, although I know I could serve you with the knowledge of your problems I now possess."

My interviewer swung me back to a seat with the suggestion that I tell him more about my work. When I finished telling about the home study course, he spoke the words I longed to hear: "Any fellow who will hold down a day job and spend his nights finding out more about his job is entitled to a thorough investigation. What's the name of the man who directs your work at the school?"

Two days later another telephone call invited me back for my second interview. Half an hour later I left the building an employe of the ——— System. I made good on the job with the ——— System. In three months my pay envelope showed a thirty percent increase over the first month. When some time later I decided to leave the ———System for another type of work, my chief paid me the highest compliment I have ever received in my life.

Home study courses have proven to me their benefits in the fields of traffic management, education and the ministry. More than that; they tell plainly, and in a short time, whether one has what it takes to make a success in any line of work.—*R.E.C.McD., Massillon, Ohio.*

OLD BOX CAMERA SERVES AS MICROSCOPE LAMP

FROM a discarded box camera you can easily make a microscope lamp that will give light of three different colors. Remove the front of the camera and take out the small nail that holds the diaphragm lever. You will find three holes in this lever. Use a 5/16-in. drill to make them all the same size. Cement colored cellulose wrapping material over two of the holes and leave the third uncovered. The color changes are made simply by sliding this lever up or down.

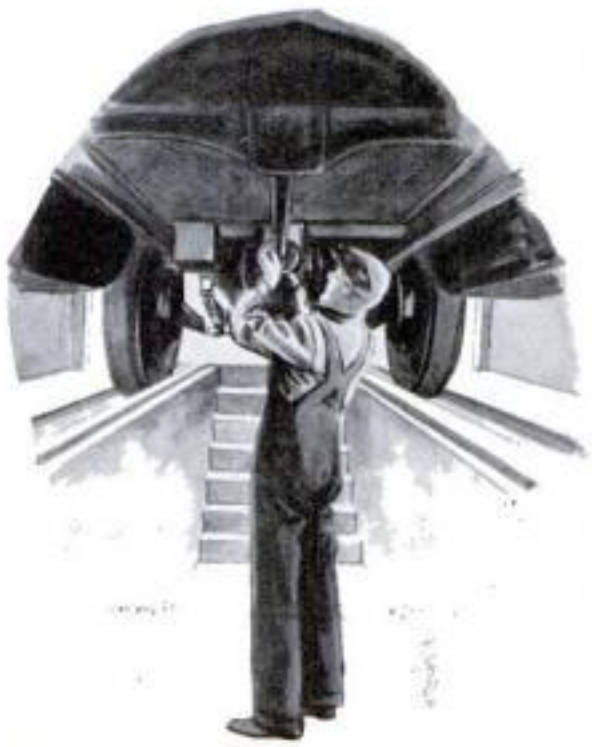
I use a 30-watt bulb and lead the wires through the small opening in the back of the camera intended for watching the exposure numbers. If a larger bulb is desired, it would be better to cut a hole in the back for the socket.

When the lamp is in use, the stop for time exposures is pulled up into position to give a continuous beam of light. This lamp is especially efficient in photomicrography because the light can be turned off instantly by closing the shutter.—ROBERT BARTLETT.

AUTOMOBILE SERVICING PIT FOR HOME GARAGE

THE amateur mechanic who wants to service his own car will find the time and money spent in building a home servicing pit a worth while investment. Too frequently the individual car owner neglects the necessary tasks of greasing and changing crank case oil simply because he does not relish the idea of crawling around on the oily floor of his garage. A pit similar to that shown removes this objectionable feature; furthermore, it will increase the sale value of the property.

Logically, the time to construct such a pit is when the garage is being built, but



Car servicing is an easier task when you can work standing up in a roomy repair pit.

if the floor is already in place, the concrete can be cut to make room for the pit, the steps that lead down to it, and the runway slots on each side.

The amount of work required in building the pit will vary with the type of soil in your locality. If the soil is firm, the sides of the excavation will serve as an outer form for the concrete. In loose soil, however, both inner and outer forms will be necessary. Forms for this type of work are built in exactly the same way as foundation forms. However, the inner forms do not extend down as far as the outer ones; this is to allow for the base slab, which is poured first. Forms for the walls and steps should be made of fairly smooth 1-in. stock and should be well braced. Old crank case oil, smeared on the inner faces of the forms, will make the removal of the boards much easier when the work is completed.

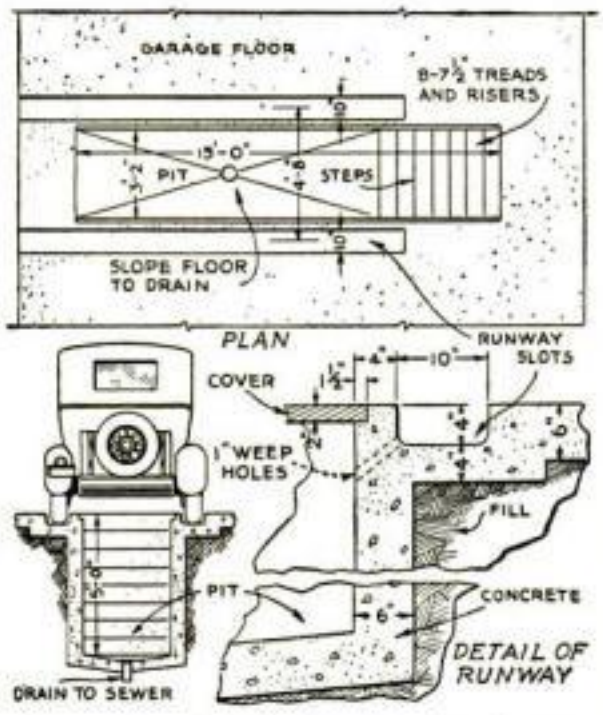
In order to provide the proper drainage and a firm footing for the base slab, a 6-in. fill of gravel or cinders should be placed in the bottom of the excavation.

A trial batch of concrete should be made, using 6 gal. of water for each sack of cement, together with 2 cu. ft. of sand and 3 cu. ft. of pebbles (or crushed stone). These specifications apply only if the sand and pebbles are dry. If the aggregates are moist, use only 5 gal. of water in the mix. Once the right consistency is obtained, the same proportions should be used for

the remaining batches that are required.

The concrete for the base slab, which is poured first, is placed directly on top of the gravel or cinder fill. This mix should be thoroughly spaded to remove any air bubbles. The floor should be sloped to the central drain with a strike board. After the mass has stiffened somewhat, it should be troweled to insure a smooth surface. Troweling also compacts the surface of the concrete and makes it relatively impervious to dirt and oil.

In laying the concrete for the walls and steps, it is best to build them up in even layers. Place an 8-in. layer of concrete all around the walls and in the form for the bottom step and spade it thoroughly. Repeating this process, fill the forms up to the top level. The steps should be struck



Plan and sectional views showing the construction of pit. Note shoulders for cover.

off with a strike board and then troweled.

While not wholly essential, a cover for the pit may prove desirable. If this is the case, a shoulder for the planking should be made by nailing two 1½ by 2 in. strips of wood level with the inside top surfaces of the two inner side forms.

Weep holes, to allow drainage from the runway slots, can be made by casting short sections of 1-in. pipe in the top layer of the concrete. If the pipes are greased they can be removed when the concrete has set.

Placing concrete on the floor or patching the break between the old floor and the pit is all that remains to be done. Troweling the floor will provide a smooth surface.—E. E. DUFFY.

SPECIAL EYEBOLTS—AND A TIP ON SHOPPING

WHEN you are held up in your work for lack of special hardware or other materials that cannot easily be obtained, it pays to look around for substitutes. For example, I needed two small eyebolts about 1½ in. long, and the usual round of the hardware stores netted nothing—not even something "just as good!" Then I discovered quite by accident a drawer handle with two such bolts attached, all for a nickel.—M. E. BLAKE.

HOUSEHOLD DYES USED FOR STAMP-PAD INK

The dye powder is mixed with equal parts of hot water and glycerine, and then filtered

BY DISSOLVING any shade of ordinary household or clothing dye in a mixture of half glycerine and half hot water, a satisfactory ink for stamping pads can be made. The mixing is best done in a tin can, which may afterwards be discarded, because the dye causes a stain that is difficult to remove.

For about half a cup of the mixture of water and glycerine, use about as much dye as will lie heaping on a knife blade. Stir with a stick and let it remain until cool. The whole can now be poured into a funnel containing a loose pledget of absorbent cotton, which will act as a filter and remove all undissolved particles.—R. W.

UNDERGROUND TAR PAPER KEEPS BASEMENT DRY

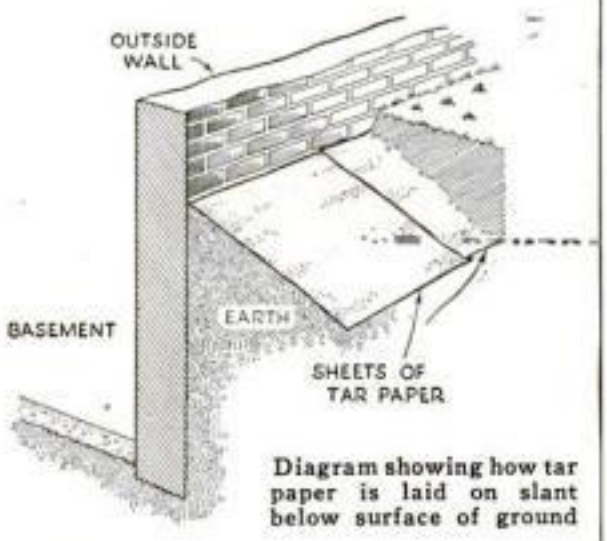


Diagram showing how tar paper is laid on slant below surface of ground

MANY basements become damp or even wet during heavy rainstorms because water seeps through the walls. This trouble can be cured in many cases by the method shown. The earth is scalped off, beginning a few inches below the surface of the ground at the basement wall and slanting down to a depth of 18 in. at a distance of 4 ft. from the wall. A good grade of tarred roofing paper is then spread over this slanting surface, and the earth tamped back in place. This causes the water that would otherwise run down the wall to be drained away from the building where it cannot seep through the wall.

It will be found that the grass will grow as well as ever above the layer of tarred roofing paper.—LESLIE G. ROLLER.

BRONZING WITH VARNISH

BRONZE powders have a tendency to turn green when used with ordinary varnish because the latter may contain a small quantity of acid. To remove the acid, add an ounce of ten percent caustic soda solution, in water, to each quart of varnish. Shake it well three or four times. When the mixture is allowed to settle, the varnish will separate from the water solution and may be poured off for use. —K. M.

HOW TO MAKE A Potato *and* Banana Band

For barn dances and parties, you can get up a "Hill Billy" band with homemade instruments painted to resemble common fruits and vegetables. *Left:* One of the finished instruments lying in its plaster mold

Novel musical instruments like ocarinas formed from ordinary clay in shape of various fruits and vegetables

By R. H. JENKINS

Professor of Industrial Education
Humboldt State Teachers College, Arcata, Calif.

MUSIC has been played on many instruments, but one of the simplest and most novel types can be obtained indirectly from the vegetable garden.

In any music store may be purchased a little instrument known as an ocarina. It is really a whistle made of clay, and, because of its shape, is sometimes known as a "sweet potato." Though not extremely melodious, it is easily played and affords a great deal of entertainment.

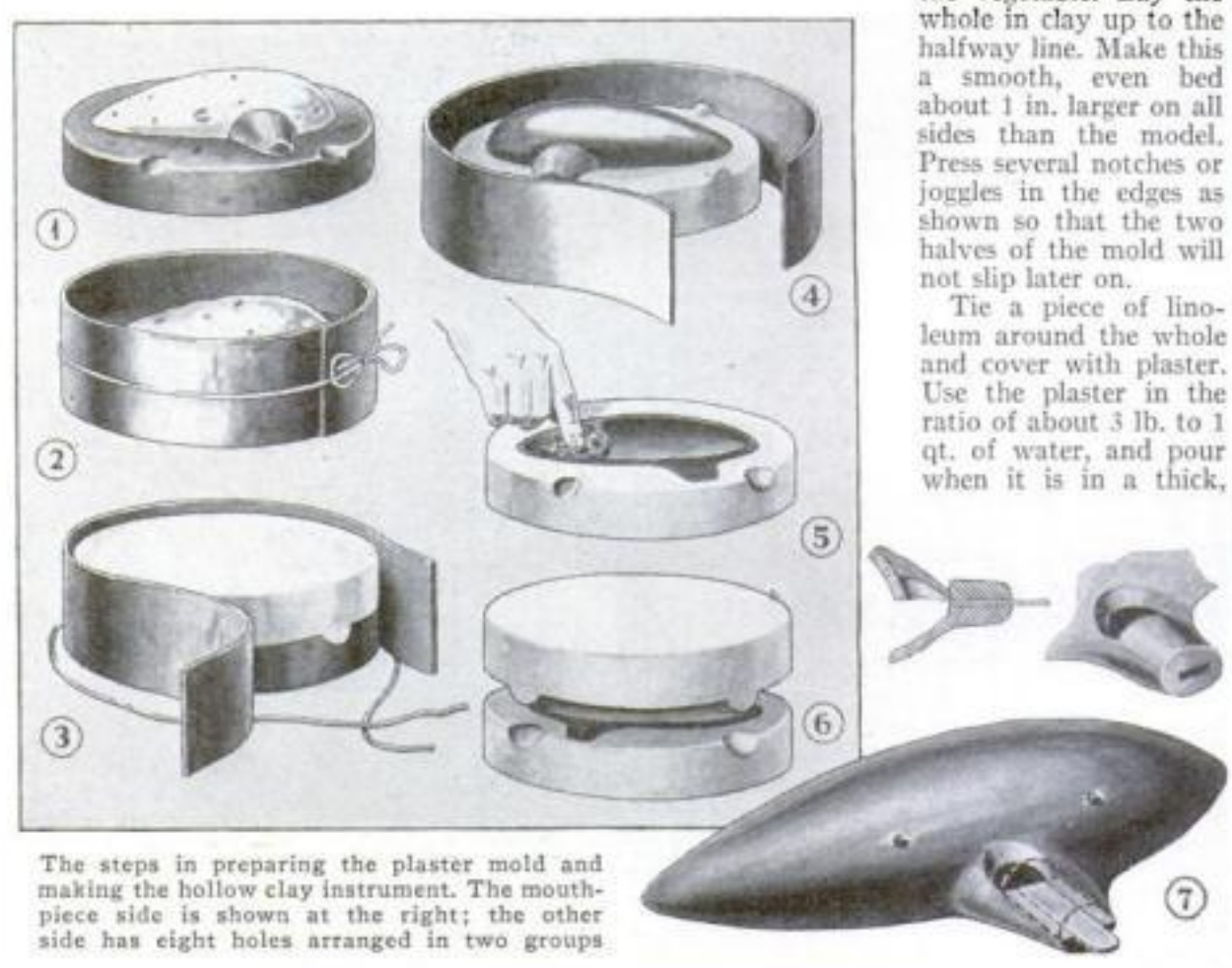
The writer became interested in comparing the shape of the ocarina with vegetables other than the sweet potato, and found that an instrument of similar quality could be made at home from any vegetable or fruit of a like form. Carrots, turnips, Irish potatoes, beets, parsnips, and bananas were tried with equal success. Only two requirements seemed necessary. The air chamber had to be irregular, and the air must be blown in from the side instead of the end.

The construction is so simple that the work is within the range of anyone who wishes to spend a few hours in making these novel instruments.

Buy, or borrow from a friend, an ocarina to be used as a guide. Purchase or dig from a bank 3 or 4 lb. of clay, and buy about 6 lb. of plaster of Paris or, still better, casting plaster, which is ground finer and sets more quickly.

Choose for the first instrument a vegetable of similar form to the ocarina. Draw a line around this vegetable the long way, in such a manner as to divide it into two equal parts. Model a solid mouthpiece like the ocarina's and stick it in place on the vegetable. Lay the whole in clay up to the halfway line. Make this a smooth, even bed about 1 in. larger on all sides than the model. Press several notches or joggles in the edges as shown so that the two halves of the mold will not slip later on.

Tie a piece of linoleum around the whole and cover with plaster. Use the plaster in the ratio of about 3 lb. to 1 qt. of water, and pour when it is in a thick,



The steps in preparing the plaster mold and making the hollow clay instrument. The mouthpiece side is shown at the right; the other side has eight holes arranged in two groups

creamy state. As soon as the plaster is hard, remove the linoleum wall, tear away the clay, and coat the face of the fresh plaster with vaseline to keep the two halves from sticking. Tie the linoleum around once more and, with the vegetable still in place, pour in fresh plaster to form the second half of the mold.

With a case knife pry the two halves apart and take out the model. Rub into each half of the mold a thin, even layer of clay, except at the mouthpiece, which should be modeled solid. Dampen the edges of the clay and press the two halves together. Whittle a thin strip of wood the exact size of the mouth opening and set it in place to form the opening through which the musician blows. Cut the other opening shown, and model a thin sharp edge for the air to strike against. Have this sharp edge

Collection of finished instruments. These may be painted as realistically as desired

in direct line with the edge of the stick. In other words, follow the ocarina mouthpiece as nearly as possible.

When the modeling is well done, carefully remove the stick and test the work by blowing upon it. A low, deep whistle should result from this effort. Take a nail and pierce the two holes on the open mouthpiece side, and then the eight holes on the opposite side. Make all holes small at first; then tune the little horn by increasing the size of the holes. The larger the hole, the higher the pitch.

If trouble is experienced, examine the mouthpiece. The little strip of wood may be slipped in again and the opening lined up with the sharp edge. Remember, too, that this mouthpiece strip must be thin so as not to let in too much air. The edge at the end of the strip must drop off at a right angle and the edge be sharp for the air to strike against.

When the modeling is finished, lay the piece away until perfectly dry, and then prepare to fire. To do this, bury the horn in a can of dry sand or dirt, and put the can in the fire chamber of a stove or fireplace. Keep a good fire going for several hours; then let the clay cool gradually as the fire goes out. When perfectly cold, the horn will be found well baked and ready for use. It may be painted any desired color.

The experiment will insure a great deal of fun, and is well worth trying. Several instruments may be tuned together so that a group can play at the same time.

USING SOLDER ON CAST IRON

THERE are various special ways to solder cast iron, but I merely use a solution made from about a quarter of a glass of muriatic acid, sufficient zinc to "kill" the acid, and several pieces of copper wire. The copper is dropped in while the acid and zinc are still in action. Try this on any piece of cast iron that has been filed bright. I have often used it for soldering the water jackets of automobiles that have been cracked from freezing or overheating. In such cases I chip out the crack with a diamond-point chisel and file the surface clean; then apply the solution, and solder in the ordinary way.—R. C. PRITCHARD.

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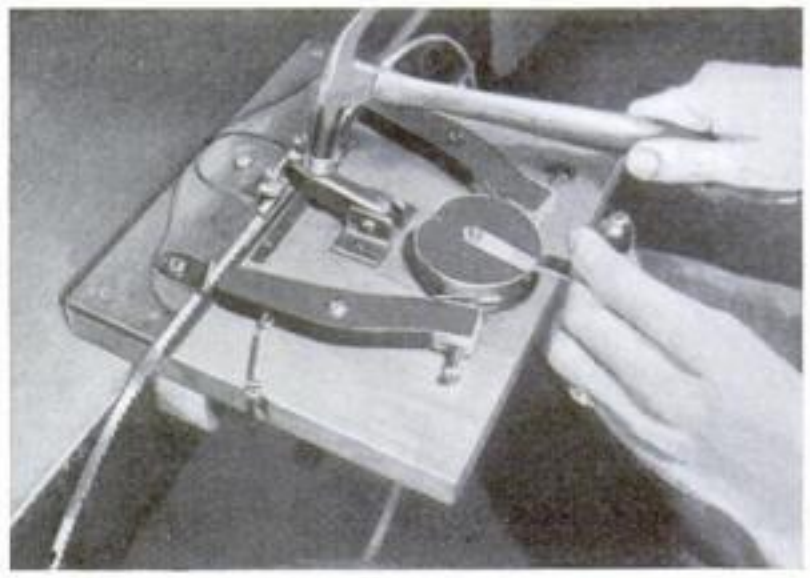
Machine *for* Setting Band Saws

SETTING band saws by hand is a difficult and tiresome task, but the homemade machine illustrated enables any band saw from ⅛ to ½ in. wide to be set accurately, quickly, and easily. One turn of the cam at a time aligns every other tooth over the anvil, and a light tap on the anvil hammer with a small hammer then sets the teeth. After half of the teeth have been set, the saw is turned over and the other half are set the opposite way merely by engaging the finger of the cam follower on the opposite side.



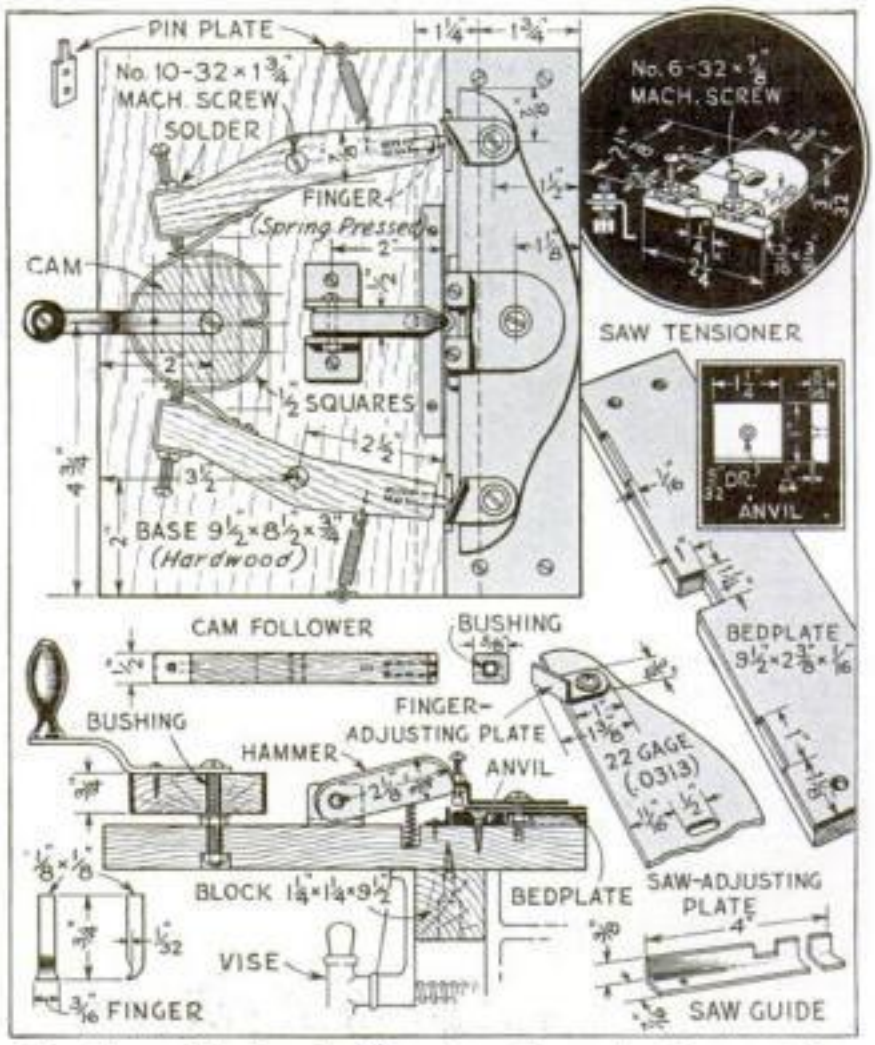
Setting a ¼-in. band saw with the device. The anvil is tapped, then the handle is turned to move the blade along two teeth more

The construction is clearly shown in the drawings below. Use hardwood for the base and other wooden parts. A piece 1¼ by 1¼ by 9½ in. is screwed under the base as indicated. To the upper side glue and nail a piece ¼ by 2⅜ by 9½ in., the piece being cut out to fit the anvil. The square nuts for the machine screws that hold the sheet-iron adjusting plates and the saw tensioner in place are fitted into the wood as indicated and held with the bedplate.

The anvil and hammer are made from steel and hardened after being filed to shape and drilled. The mounting for the hammer is made from ¾-in. angle iron. The saw guide is formed from 1/32-in. brass and screwed in place against the anvil.

The cam is cut from a piece of wood ¾ in. thick, and the edge is bound with a piece of brass 1/32 by ¾ by 8 in., the ends being bent and soldered into a slot, which is cut in the lowest point of the cam. The cam rise is ⅝ in.

Make the cam followers from ½ by 3 by 5½ in. wood. Drill holes for the bushings, which must be a free fit on the machine screws. Reënforce the cam end with brass, and solder the machine screw nut to it as shown. On the finger end, insert a piece of square brass tubing measuring ⅛ in. square on the inside. File the finger from a piece of steel to the dimensions given. This is then hardened. The small springs that keep the finger in contact with the saw are taken from tire valves.



How the machine is made. The nuts on the saw tensioner are soldered in place, and the lower ends of the two machine screws are filed to 3/32 in. in diameter for riveting to the tensioner bar

After the machine is assembled and the saw put in place, the adjustments necessary will readily be seen. If the tooth does not align directly under the hammer, a slight turn of the screw on the cam follower will bring the tooth in line for setting. After this has been done, the adjusting plate must be set so the finger will take every second tooth with one turn of the cam.

The tension on the saw is controlled by raising or lowering the tensioner bar. If ⅛ in. saws are to be set, an extra plate is placed under the saw tensioner. This is cut from 3/32-in. iron in the same general shape as the saw tensioner, but is flat except for a 1/32-in. lip, which is turned down along the front edge.

A little studying of the machine will soon familiarize one with its working, and the setting of band saws will thereafter be easy to do.
—EDWIN PUTZER.

LIGHTHOUSE KEEPERS OF THE SKY

(Continued from page 15)

broke. A repair job at a machine shop would have taken the station off the air for several hours. B. H. Barker, the man at the radio, did some quick thinking. Fishing rubber bands from his desk, he wound them around the key so that they took the place of the useless spring. With this makeshift repair, the apparatus kept going for several days until a new part arrived from the manufacturer.

In addition to the equipment at the intermediate fields, the airways have automatic revolving beacons spaced fifteen miles apart. An airways mechanician services a 200-mile sector, making regular trips to see that the apparatus is in good order. Each beacon holds two bulbs, the second slipping automatically into place if the first burns out. At some of the most isolated beacons, caretakers live near the towers and devote all their time to tending the one light.

LONELIEST of these mountain lighthouses is one on a jutting rock 6,860 feet above sea level at Little Lake Pass, Nev.

During winter months, the only way to get to and from the station is on snowshoes and the caretaker communicates with the outside world by means of light signals. Using a prearranged code, he flashes messages to the nearest other beacon, eighteen miles away, at Silver Zone, Nev.

On all the airways crossing the western mountains, snowdrifts add tremendously to the work of the airways field men. Near Rattlesnake Ridge, Wash., for instance, William Graham and his helper had to burrow through a thirty-foot drift to get into the power shed of an isolated beacon.

Then, when they started to leave, they found the tunnel had caved in, jamming shut the door of the shed. By removing the sash from the window, they were able to dig their way to open air. From outside the building, however, they could not replace the sash. So they had to dig out the first tunnel again, replace the window from inside the shed, and leave by the door.

Because of the heavy snowfalls in the Rattlesnake Ridge region, the metal cabinets housing the switches and astronomical clocks are being placed thirty feet up on the towers instead of in their usual positions at the base. This saves hours of back-breaking digging during winter months.

Electrical storms, with their lightning flashes, always form a spectacular hazard for the airways men. Three or four years ago Charles Irish had a hair-raising experience with a thunderbolt at the Amarillo station.

IT WAS early in July. About midnight, the storm broke over the field. Irish was just reaching for the microphone to broadcast the weather when the whole room seemed filled with blue, running flames.

A friend, who was driving down the road at the time, told him later he saw a ball of fire run along the 125-foot antenna wires and down the lead wire into the radio shed. The bolt circled the room from one electrical apparatus to another, leaving Irish in the center unharmed.

In complete darkness, with the air filled with acrid fumes, he groped for a flash light and found that every piece of apparatus in the building was out of order. Driving four miles through the storm, he reached a telephone and sent out an S.O.S. for a repair man with spare parts.

In the work of an airways keeper, there is little fanfare or ballyhoo. The risks he meets are part of his job. The emergencies he overcomes are taken for granted. But, quietly, efficiently, he is playing his part in bringing greater safety to the sky.

EASILY MADE

Tin-Foil DESIGNS

Gleam with Brilliant Metallic Colors

Binding edges of a parrot design, which is painted on glass and backed with metal foil

BRILLIANT, modern-looking wall pictures or decorations can be made from common tin foil and foil papers. A variety of such papers can be obtained from package wrappings in silver, gold, and other colors. They provide the mainstay of the work. Other items required are a sheet of glass, enamel and lacquer, and a design to follow.

A parrot design was chosen for the picture illustrated. A sheet of glass of the size of the finished picture is placed over the design, which is traced with a fine brush and black enamel. Only the outline and important parts are marked. When this is finished, use some transparent lacquer in different colors to fill in the design, following the colors of the original as closely as possible. It is wise at this time to see that one particular color predominates and that it matches the color scheme of the room in which the picture is to be hung. Much contrast is permissible, however, as the coloring must be brilliant to be effective. If genuine transparent lacquer is not available, use clear lacquer to which dyes have been added.

After coloring, the next operation is to fill in the background (in this case, around the parrot and foliage) with black enamel, applied in a thick coat. Then crinkle up a sheet of tin foil, open it again, and apply it with transparent cement wherever desired to form a background that can be seen through the lacquer colors when the picture is viewed from the right side—that is, from the unpainted side of the glass. This increases the brilliance of the colors. Obtain a sheet of gold-foil paper, such as jewelers use for wrapping their wares, and cement it down over the entire back of the design. This will give a background for any parts not covered with tin foil.

The picture is finished by fastening a sheet of heavy cardboard to the back and binding the edges with picture-binding tape. Suitable hangers are attached for wall use, or the picture can be placed in an ordinary photograph frame for use on a table.—E. A. BOWER.

Left: The outline is drawn or traced on glass with a brush and black enamel. *Below:* Cementing pieces of crinkled tin foil over parts of the painted design

Above: The spaces inside the lines are tinted with transparent colored lacquer and backed with the foil, which shines brilliantly through the lacquer. *Right:* Placing the colored foil backing sheet

BARNUM'S MUSEUM

(Continued from page 17)

open the door and find themselves on the street, unable to enter the building again without paying another admission fee.

Around the whole exhibit, which will provide a Christmas attraction for a chain of eastern department stores in New York, Philadelphia and Pittsburgh, Pa., there will be immense side-show banners, painted in brilliant red, blue and orange. In the unrestrained language of Barnum, they will set forth the amazing wonders to be seen within.

One hundred and ten feet long and eighty feet wide, the exhibit will contain reproductions of most of the famous attractions which once appeared in Barnum's American Museum. This five-story structure on lower Broadway, near City Hall Park in New York City, contained at one time nearly 600,000 oddities, curiosities and freaks of nature.

It was the American Museum that gave Barnum his start as a showman. At its height, there were no large free museums in New York and after 1841, when Barnum took it over, it was famous for more than a quarter of a century as an amusement center of the city. Twice it burned down, once destroying virtually the whole $400,000 collection it contained. Each time, it was rebuilt.

Before starting work on their exhibit, the experts of Messmore and Damon spent several months in research. They examined old books, newspapers and magazines dealing with Barnum and his times in order to make their mechanized reproductions a true picture of the original collection of wonders.

For many years, this firm has been noted for its huge and spectacular displays of mechanized monsters. Applying the latest aids of science, its engineers have created moving, lifelike figures that range from representations of comic-page heroes to scientifically accurate reproductions of prehistoric monsters. In preparing many of their exhibits, the men have collaborated with scientists from the American Museum of Natural History and other institutions to give scientific value as well as amusement appeal to their displays.

EXPERIMENT SHOWS HOW FORESTS MAY BE SAVED

WILL scientific lumbering methods save our remaining forests? Conservation advocates, who continually try to tell us so, can point at last to a convincing example—the 95,000-acre Whitney Preserve in the Adirondack Mountains of New York. In 1898, lumbermen followed a plan laid down by the United States Division of Forestry for logging the area, and cut enough pine and spruce to bring the owner and contractor fortunes. Spared from the ax, however, were the firs, hemlocks, hardwoods, and all spruce nine inches or less in diameter. Foresters predicted at that time that a second crop as large as the first could be cut by 1935. As this is written, according to the New York State College of Forestry, the second cut is well under way and is more than fulfilling the prediction, proving that a forest may be lumbered indefinitely, without damage, if sound principles are followed.

HORSES AND MULES ARE RETURNING TO FAVOR

LAST year, there were 10,000,000 fewer horses and mules in the United States than there were in 1920. Additional statistics of the Horse and Mule Association, however, indicate the animals are rapidly returning to favor, largely because they can be fed with oats and other products of the soil which the farmer can raise himself. Interest in hunting, polo, and riding for pleasure also is said to be stimulating the return of the horse.

TANKS—PEACEMAKERS OR WAR BRUTES?

(Continued from page 28)

go off roads and cannot cross battlefields. The Infantry now have a "medium tank" designed on what are generally called the Christie principles, weighing twelve tons. It is driven by a Curtiss airplane engine and carries a crew of four men and, perhaps, even a one-pounder cannon in addition to machine guns. There are no American land battleships with heavy cannon.

But Mars has contrived many improvements. For armored cars he has evolved an armored hull that is also a chassis, to which are attached axles and springs carrying the wheels. For tanks, he has reduced driving fatigue by a vacuum booster to operate steering clutches and brakes, and four gear speeds.

He has made life bearable for the tank crews. Power-operated blowers will clear the air of engine heat, fumes, and gas. A new type of insulation will stop hot lead from bullets from coming through narrow peep slots to blind them. They can hide by emitting smoke screens. In battle, the tank crews can talk to one another by radio telephone, through special padded helmets.

"BUT," some one asks, "what will the tank crews wear? Armor?"

That question is not so ridiculous as it may sound. In fact, it is keeping some tank experts awake at night, and they haven't found the answer. That is why General MacArthur says:

"The idea that some particular machine will completely dominate battlefields of the future, is a figment of the imagination. Such contentions ignore not only mechanical limitations, but also the ingenuity of man in developing neutralizing agencies for the engines of destruction he himself has created."

For instance, winged bullets. There is a new bullet, called the Gerlich Halger-Ultra, invented by a German. Circling it are two wings or flanges, made by cutting two rings around the jacket and turning them up at an angle of forty-five degrees. These wings or flanges fit into the grooves of the rifle barrel, which is made in three sections—a wide, cylindrical base, an intermediate cone, and a narrow muzzle tube. As the winged bullet shoots through the barrel, no gas escapes and all the driving force of the charge is used. At the same time, the bullet's passage through this tapering space gradually folds the wings back into place, flush with the surface of the jacket, so that wind resistance will not slow it in flight.

WHEN the bullet emerges from the muzzle, it is traveling about twice as fast as an ordinary bullet from an ordinary gun, and its striking power is increased proportionately.

Will the doughboy, with his little bullet, slay the giant tank? Suppose that, in those fierce, brief two minutes of crucial combat when the tanks are rushing upon the trenches, the infantry have machine guns, rifles, even pistols, shooting these miraculous new winged bullets. Suppose the bullets not only pierce the tank's armor, but explode inside the tank, among the crew.

Put thicker armor on the tank? But that means a heavier tank, after seventeen years of effort to make it lighter by using electric-arc welding, lighter steel, and aluminum. And, to move that heavier tank takes a bigger motor which means, probably, a slower tank and a larger one.

Once let that start, and the new tank of 1935 has backslid to the weaknesses of the old World War tank.

There is the vicious circle. To break it is the task of science and invention. Which will win, the doughboy with his winged bullet, or the tank with its new strength and speed? That, today, is the riddle of the tank, that every nation is trying to solve.

STUNTS WITH THE CHEMICAL TRIPLETS

(Continued from page 53)

cut off, mounted in an inverted position; and a spoon made by fitting a stiff wire handle to a metal screw-on top of a can. A flow of illuminating gas is admitted to the bottle through a cork in the neck. Place the strontium or barium chlorate in the improvised spoon and heat it until it commences to liberate oxygen gas. Then lower it immediately into the chamber filled with illuminating gas. The chemical burns with a dazzling flame, tinted by the characteristic color of the chemical used.

Because of the vivid color these chemicals impart to flames, they find an important use in fireworks. Strontium compounds, for example, are responsible for the vivid color of the "red fire" used in Fourth of July and political celebrations, and of red flares used as danger signals. You can easily make one of these red-fire preparations in the home laboratory, by mixing intimately sixty-six parts of strontium nitrate; twenty-five parts of potassium chlorate; and nine parts of powdered orange shellac. The latter should be bought in the powdered form, since pulverizing it is rather difficult. Another simple red-fire formula is: strontium nitrate, eight parts; sugar, four parts; potassium chlorate, one part. When either of these mixtures is ignited, it will burn with a dazzling crimson flame. A green fire may be prepared from barium chlorate or nitrate; six parts of barium nitrate, three parts of potassium nitrate, and two parts of sulphur will give a satisfactory preparation. The proportions for all of these mixtures have been given in parts by weight, and any convenient unit of weight, such as an ounce, or a quarter-ounce, may be substituted for "part" in the formulas above. For best results, the ingredients should be weighed out carefully in the exact proportions given.

FOOD MIXTURE CONTAINS ALL MATERIALS NEEDED

SEEKING an ideal food for invalids and convalescents, research chemists of a Bridgeport, Conn., laboratory report that a world-wide search for suitable ingredients has finally yielded a satisfactory compound. The mixture, named "manatone," consists of banana pulp, ground coconut, malted milk, skimmed milk, whey, and dextrose, with the addition of cocoa for flavoring. It is reported to satisfy the requirements imposed upon the experimenters which were: that the food should be pleasant to the taste; that it should contain all nutrient materials, vitamins, and mineral salts needed by the body, as well as enzymes that would make it partially self-digesting; that its fats and proteins should be in easily digestible form; and that it should consist wholly of natural substances, excluding synthetic ingredients whose properties might not be fully known. Thousands of combinations of ingredients were tested before the mixture was finally selected.

AN EXPERT TELLS YOU HOW TO PRUNE SHRUBS

(Continued from page 48)

tying the main stem to a wooden stake two inches square, or to an iron pipe. Since the tying serves as a guide and not as a support, strings or tapes should be tied tightly around the stake and loosely around the stem of the tree. They are best placed one foot apart and sufficiently loose to permit a movement by the tree of three inches in each direction. Loose guides prevent binding of the trunk and also permit the plant to develop strength. Slight variations or waviness in the stem will be outgrown as the trunk develops.

NEXT, establish the height of head, or the distance from the lower limbs to the ground. No limbs should be allowed below a height of six feet. When a small tree is planted, allow nothing but the tip or terminal bud to develop. Pinch off any side or lateral branches, which usually come out at the axil or base of a leaf, as soon as they are formed, but do not remove the leaves. Continue pinching off lateral growth until the top has reached a height of six feet, and from then on the tree will shape itself.

Some varieties are easily blown aslant by the prevailing wind. As a precaution against this in planting, the trunk may be trained into the wind at an angle of about fifteen degrees from the perpendicular. Do not tie back or straighten a wind-slanted tree artificially, for the support may break later and the whole tree go down as a result of being weakened by outside support. By trimming wind-blown trees on the lower part of the heavy side, you will force new growth on the light side. In this way the tree may be straightened up without weakening its general structure.

As shade trees become older, weight of wood and leaves will pull the lower branches down, until they interfere with the free use of the lawn. Do not prop these branches up and try to save them. Saw them off wherever they become a nuisance, and new growth will be formed higher in the tree.

Unlike most ornamental trees, Arizona and Monterey cypress require no pruning, but the tall, slender Italian cypress and its hybrid relatives which resemble it closely, will need some occasional attention. When these cypress trees begin to send out side branches that show a tendency to fall away from the main column of the plant, do not, under any circumstances, tie them back in place. Tying merely prolongs the agony of a complete failure of the desired type. Using long-handled shears, cut off the ends immediately inside the main foliage. This will cause lateral growth to shoot out below the cut and the hole made by the removal of the branch will soon be filled.

A light trimming of the outside tips, particularly where the tree is used as a formal specimen, will smooth up its appearance.

FLOWERING trees, such as flowering peaches, provide unusual beauty in the spring. Heavy cutting is required to produce more and finer blooms on these. In fact, you can double the life of flowering trees by adequate pruning, starting as soon as the plant has put out its first crop of blooms and continuing every year thereafter.

Cut out severely all of the past season's growth as soon as the petals have fallen, leaving short stubs four to six inches long. New flowering wood will soon spring from these stubs and will have ample time in which to develop for next season's flowers. The peach, being a weak wood, tends to develop internal rot when growing slowly, and this system of pruning will keep the tree in vigorous, continuous growth. Although the sap will be active at pruning time, and some gum may exude on the bark, there is little danger of sour-sap harming the tree.

NO PLACE LIKE HOME—TO GET HURT

(Continued from page 35)

front of a bank window depositing your weekly pay check? The answer is, you cannot be sure, no matter where you may be, that chance will not reach out to inflict injury in greater or lesser degree.

One mishap led to the discovery of an earlier one. Mrs. Josephine Illman, of Milwaukee, Wisc., accustomed to sewing for many years, plunged a needle into her thumb. She was rushed to a hospital for X-ray photographs. The pictures not only revealed that needle, but also showed embedded in her hand a smaller one which she remembered "losing" long ago.

Several workers in a New York dressmaking establishment suddenly slumped in their seats. Investigation revealed that fumes containing a poisonous gas were blowing in through open windows from a freshly painted roof next door. They were asphyxiated by an out-of-doors painting job, an almost unheard-of accident.

HUNDREDS became panic-stricken in a theater at Bogota, Colombia, when some one shouted, "Fire!" Several fell from the balcony on those below; one was killed, a score were injured. Some practical joker had shouted the alarm. There was no fire.

Frank Coltrin, of San Jose, Calif., went fishing in a mild surf near San Francisco's Golden Gate. While standing in water hip-deep, an octopus seized him, wrapping long tentacles around both legs and one arm. His companion, Harry Simmons, went to his aid armed with a butcher knife. As quickly as he severed one tentacle, another seized his friend. Only when Simmons plunged the knife between the octopus's eyes did the creature loose its hold. Rings left by the powerful suction cups were found on several parts of Coltrin's body.

Although less danger attended the incident, directors, clerks, and customers in an eastern bank suffered considerable discomfort the other day when the building became flooded with tear gas, intended only for bandits. An electrical short circuit set off the gas sprinkling system, and the gas drove scores from the building. A few minutes later, business was resumed as usual.

Birds and animals play leading roles in many accidents, some as the moving cause, others as innocent victims. A wild pheasant weighing only six pounds knocked out Frank Pearl, engineer of a crack train roaring at seventy miles an hour through New Jersey the other day. The bird flew head-on through the narrow glass windshield which protected the engineer against wind and cinders, striking him in the forehead. Pearl slumped unconscious in his seat, but safety devices stopped the train. The train proceeded after the engineer was revived.

HARRY BALL had a similar experience on a country road near Loverna, Saskatchewan, when a rabbit leaped through the windshield of his coupe and disappeared through the rear window. Ball was severely lacerated by flying glass, and the rabbit paid the supreme penalty for its carelessness. A Hingham, Mass., family was less fortunate. One of a flock of geese walking along the road flew into the windshield and dropped dead in the car. Five of the passengers were painfully lacerated by flying glass.

When bulls and box cars mix, the results usually are somewhat more sensational. The engineer of a freight train rumbling through Georgia saw a large bull standing unconcernedly alongside the train. When the engine approached within a few feet of the animal, it stepped onto the ties. Result: locomotive and nine cars plunged into a muddy ditch, engineer and fireman killed, nine box cars demolished.

Where the next accident, of water, fire, force, or fumes, will occur none can say. Despite many efforts at safety education, the death toll increased nearly one tenth last year, when 101,000 people succumbed from mishaps of all kinds in the United States.

NO MATTER where you may seek thrills—in the air, on land, or at sea—home continues to be the most dangerous place in the world. Of the 9,821,000 disabling injuries from all causes last year, more than half happened at home.

Too, these accidents increase every year. Here are a few startling facts: Rhode Island is the only state that did not suffer an increase in fatal accidents last year. Wage loss, medical expense, and insurance cost the injured $2,400,000,000 and property damage, including buildings razed by fires accidentally started, reached the staggering total of $3,500,000,000. No disease kills as many children as accidents. One person in five may reasonably expect to be injured during the next twenty-five years.

Finally, more than twice as many people will meet accidental death at home this year as will succumb from accidents of all kinds while at work. Of these, falls and burns are the most important causes. Nearly half of the falls occur in bedrooms, more than half of the burns in kitchens. Recent studies by the Kansas Department of Health show that more people die from slipping on floors, rugs, and stairs, falling while getting in or out of bed, or while sitting down in or getting up from a chair than from all other home causes.

For safety, you must take to the bath room, which the Kansas authorities found to be the safest room in the house, with only one fatal injury in twenty there, or to the air. Statistics recommend airplanes rather than bath rooms.

BIRD SONGS RECORDED DESPITE DIFFICULTIES

BIRDS proved to be as temperamental as movie stars, when naturalists of Cornell University and the American Museum of Natural History recently toured the country to record bird songs upon sound film. A Carolina wren, instead of performing vocally for the scientists, took refuge in the sound truck and attempted to build a nest. A real mocking bird heard the recorded voice of another, while one of the Florida films was being tested, and dashed at the window of the room to drive the supposed rival away. When the cameramen lowered a microphone over a Colorado cliff, to a golden eagle's nest on a ledge 700 feet below, the eagle tried to swallow it. Despite such difficulties, the expedition obtained ten miles of sound film bearing bird calls they sought, including those of some of America's rarest species.

BRAIN WAVES MEASURE DEPTH OF SLUMBER

"LIGHT" and "deep" sleep—hitherto vague terms—may acquire definite meaning from recent tests at Tuxedo Park, N. Y. Recording the minute electrical currents in the brains of sleeping persons, experimenters recognized four distinct patterns of brain waves, which they named "random," "trains," "saw-tooth," and "spindle." These patterns seem to be directly associated with different levels of consciousness. A person who has just fallen asleep, for example, shows the "trains," but as sleep becomes more profound the wave type changes to a "random" pattern.

HERE'S THE ANSWER

(Continued from page 57)

it runs along the surface of the water for seventy to eighty yards before it can rise in the air.

A Nonwetting Fluid

Q.—WHY is it that mercury, a liquid, does not wet paper when allowed to remain on it? —D. T. H., Wilmington, Del.

A.—THE relative density, or specific gravity, of the mercury is so much greater than that of the paper that the latter does not absorb the mercury.

Trunks To Spare

J. B. D., BOISE, IDAHO. A banyan tree, in the Calcutta botanical gardens, has a main trunk thirteen feet in diameter, 230 trunks as large as oak trees, and over 3,000 smaller trunks. The banyan tree, native to India, sends down great numbers of shoots from its branches which take root and ultimately become additional trunks.

Gets Its Own Grub

S. K. B., SHREVEPORT, LA. Spanish moss is not parasitic, as commonly believed. It is an epiphyte, that is, a plant which grows on the surface of other plants and depends on them for support but not for food. And it is technically not a moss but a member of the pineapple family. Commercially, it is used for stuffing mattresses, horse collars, auto upholstery, and for packing material.

There's No Sterile Soil

C. G. A., FORT WORTH, TEX. Every soil is fertile, but all land is not fertile because all land does not have soil. Soil is formed by a progressive process. Rock must first be broken down by the weather. This weathered rock is then converted into soil by living organisms. The types of microörganisms creating a soil give it individual characteristics. The soil bacteria and plants actually develop together and each has an influence upon the other. Soils, of course, can be given desired characteristics artificially.

Preventing Carbon Smudge

Q.—IS THERE a method by which bound carbon copies can be prevented from smudging?—A. P. S., St. Paul, Minn.

A.—A SUGGESTED method to eliminate the tendency of bound carbon copies to smudge consists of melting the colored wax of the carbon print into the fibers of the paper. This may be accomplished by passing a tall Bunsen flame rapidly over the surface of the sheet. The paper should be lying on a smooth, good-conducting surface when the flame is applied. If the sheets warp slightly, they may be flattened in a press.

'Sees' With Its Eyes Shut

Q.—DO BATS have supersensitive eyes that enable them to dart about in the dark?—B. M., Mobile, Ala.

A.—IT IS the wings and ears of a bat which enable it to fly in the dark through thick forests without striking a tree trunk or branches. The wings contain a fine network of nerves by which the animals seem to be able to detect in advance the slightest vibrations caused by air currents striking solid objects. Their sense of hearing is also acute. Experimenters have sealed the eyes of bats with gum and released them in a large room where many ropes were suspended from the ceiling. The bats darted about with their usual speed without striking the ropes. The bat, incidentally, is the only mammal capable of true flight.

GUS SAYS: QUIT YOUR SKIDDING!

(Continued from page 58)

Gus wiped the grease from his hands. The hub was dismounted, and there was nothing more to be done until Joe returned with the new parts.

"Learning what to do about a skid by actually trying it would be one way," Gus smiled, "but you'd stand a fine chance of wrecking the car and landing in the hospital. The thing to do, Mrs. Dean, is to learn how to avoid a skid."

"I'd be very grateful if you could teach me that," Mrs. Dean suggested.

"Well," Gus began, "the first thing to learn is to keep your brakes in good shape. If the brakes on one side of the car are holding stronger than on the other side, you are likely to skid out of line even on dry pavement when you have to jam on the brakes in an emergency. That would mean an accident if you happened to be driving close to a line of other cars, so that swinging out would mean hooking hub caps or bumpers with one of them. Any time you notice that the car seems to have a tendency to swing to one side when you put the brakes on hard, have your brakes examined right away."

"I WON'T have to worry about that. Mr. Dean is very fussy about the brakes," Mrs. Dean interrupted.

"I know he is," said Gus. "I only mentioned it so that if he happens to be away on a trip and the brakes don't seem to be working right, you won't let it go till he gets back.

"Now," Gus continued, "a skid always follows when at least two wheels lose their hold on the road surface, or even one wheel if you are going around a sharp corner and the weight is nearly all on the outside wheels. Skids mostly are started when the motion of the car is being changed. Going around a corner is changing the motion of the car. So is putting on the brakes or speeding up. And, as putting on the brakes changes the motion fastest of all, doing this when you're going around a curve, makes it twice as hard for the tires to stick to the road. That's why most skids come on the turns.

"But your car can go into a skid even when it's moving straight ahead at a uniform speed. In that case, the crown of the road may be partly to blame, because when a car is tipped sideways on a surface that is not level, it naturally wants to slide sideways.

"Once," Gus explained, "I was driving down a wide, smooth boulevard that had only a little crown to it. It started to sleet so that it formed a thin sheet of shiny, smooth ice. My car, no matter how carefully or slowly I drove, slid right off the road into the gutter and I couldn't go on till I'd put on the chains. So far as I could see, all the other cars on the road that didn't have chains on were having the same trouble. Of course, if the road had been dead level, I could have gone on; still, it would have been mighty dangerous, because, on a surface like that, it would have been impossible to stop in a hurry."

"I'VE been told you don't need chains with these new, big tires," Mrs. Dean objected.

"Don't let anyone fool you that way," growled Gus, as Joe drove up with the new bearing and the gray-haired mechanic set to work to assemble the hub. "When the roads are covered with glare ice, there isn't anything except a pair of steel chains that will make driving even reasonably safe.

"Of course," Gus went on, as he smeared a liberal supply of grease on the new set of rollers, "the broad treads of the new tires hold better in mud or snow than the skinny tires we used to use, but rubber won't bite into the surface of glare ice, and that's what you need when its just barely freezing and the ice is extra slippery.

"Next to ice," said Gus, "come wet leaves as a cause of dangerous skids—mainly because lots of motorists don't realize that the leaves are slippery till it's too late. After ice has been on the ground for quite a while, dust and dirt settle on it and it isn't quite so slippery. But the longer wet leaves stay on the ground, the more slimy and slippery they get.

"Most people think that you'll never skid on a concrete road. It's true that dry concrete gives fine traction and even when it's wet the traction is pretty good, but I've seen some bad skids on concrete in places where a lot of sand blows on the road. If you try to go around a corner too fast on a sand-covered concrete road, the tires start to roll sideways on the grains of sand just like they were so many little ball bearings."

"You'd have to keep a sharp eye on the road, to spot all those different kinds of things before you get to them," Mrs. Dean observed.

"THAT'S the point, exactly," replied Gus, as he snapped the hub cap in place. "Keep your eye on the surface of the road ahead, and as soon as you spot anything that doesn't look just right—especially if it's at a turn—slow down right away while you still have good surface under you to slow down on. Then, by the time you get to the danger spot, you can slide over it at slow speed without using your brakes and there won't be much chance of a skid."

"But suppose you *do* skid," Mrs. Dean asked, "what do you do then?"

"If it's a back-wheel skid, turn your front wheels so they'll pull the front of the car in the direction the back wheels are sliding so as to prevent the front of the car acting as a pivot for the back to swing around. At the same time, take your foot off the brake, let in the clutch, and give it just a touch of the accelerator.

"If it's a front-wheel skid, there isn't much you can do except take off the brake, if it's on, and pull your wheels back to straight again.

"And," Gus finished with a grin, "no matter what kind of a skid it is, say your prayers —and say 'em quick!"

NAVY TELLS OF TIME AIRSHIP STOOD ON END

IF STOOD on end, statisticians once said of the U. S. Navy dirigible *Los Angeles*, the 658-foot craft would tower above all but New York's ten highest skyscrapers. Reviewing the career of this veteran airship, now retired from service, naval authorities recently revealed that once it actually did stand on end!

It was a feat, officials declare, that never has been executed by any other airship and probably never will be. With twenty-five officers and men aboard, one calm afternoon, the *Los Angeles* rode at her Lakehurst, N. J., mooring mast in a gentle land breeze. Without warning, a sea breeze sprang up in exactly the opposite direction. The colder incoming air caught the ship directly under the tail and lifted it. Before ballast could be shifted or other means taken to trim the craft, it was standing on its nose, with the tail up at an angle between eighty-five and ninety degrees.

Swiveling on its nose spindle, the topsy-turvy airship then faced about into the sea breeze and came to rest on an even keel. The men aboard, tossed about as they were, had not even a scratch to show for their remarkable experience. The *Los Angeles* showed unsuspected strength by this freak demonstration but a second performance was not desired. The incident hastened the discarding of the tall mooring mast then used, in favor of low, stub masts which permit the stern of an airship to be anchored to a traveling carriage on circular rails.

TWO-TUBE SET BUILT WITH SPARE PARTS

(Continued from page 55)

any position of the plug is satisfactory.

For long-distance work, it is imperative that a good antenna be used. First of all, the antenna itself should be located as far above the roof top as possible, or stretched out in the clear, well away from buildings and electric lines. The proper setting for the antenna condenser will have to be determined by experiment.

To tune the receiver, turn the regeneration control to the right. This turns on the power supply. When the tubes have warmed up, advance the regeneration control until a rushing sound is heard from the loudspeaker. Then turn the tuning condenser slowly until a station is heard. If the regeneration control is advanced too far, a whistle will be heard or the signal will be muffled and indistinct. Turning the control back and changing the dial setting of the tuning condenser will clear the signal. This apparent change in tuning is brought about by the action of the feedback, since it tends to alter the inductance of the circuit, necessitating changes in the capacity.

As with any regenerative receiver, the tuning condenser must be adjusted slowly. Even after a station has been tuned in, it is wise to readjust carefully the dial in an attempt to find a better setting.

The coils, L_1, L_2, and L_3, are standard six-prong, plug-in coils. They may be bought, or wound in accordance with the following specifications:

COIL WINDING DATA

Coil Range Meters	Primary Turns	Tickler Turns	Secondary Turns
17- 41	6	4	9—No. 16 Enam., 7 to in.
33- 75	12	6	18—No. 16 Enam., 12 to in.
66-150	25	11	38—No. 24 Enam., 24 to in.
135-270	50	17	82—No. 28 Enam., 44 to in.

Primaries wound with No. 34 dsc. wire. Ticklers wound with No. 32 dsc. wire. The primary windings are interwound with the secondaries starting at the ground end and have the same number of turns per inch as the secondaries. All windings are in the same direction.

If carefully built according to the diagram and instructions, the outfit will give surprisingly good results for a small AC-DC circuit. The original receiver is the best all-around two-tube set the author has had the pleasure of using and its volume on the loudspeaker surpasses that of many four-tube outfits.

LIST OF PARTS

C_1.—Variable condenser, 75 mmf.
C_2.—Variable condenser, 140 mmf.
C_3.—Fixed condenser, .000125 mfd.
C_4.—Fixed condenser, .0001 mfd.
C_5.—Fixed condenser, .5 mfd.
C_6.—Fixed condenser, .02 mfd.
C_7 and C_8.—Electrolytic condensers, 12 mfd., 200 volts.
C_9.—Electrolytic condenser, 25 mfd., 25 volts.
C_{10}.—Fixed condenser, .02 mfd.
C_{11}.—Fixed condenser, 1 mfd.
R_1.—Fixed resistor, 1.5 megohms.
R_2.—Fixed resistor, 250,000 ohms, ½ watt.
R_3.—Fixed resistor, 500,000 ohms, ½ watt.
R_4.—Variable resistor with switch, 20,000 ohms.
R_5.—Fixed resistor, 30,000 ohms, 1 watt.
R_6.—Line cord and resistor, 315 ohms.
R_7.—Fixed resistor, 1,500 ohms, 1 watt.
R_8.—Fixed resistor, 1,500 ohms, ½ watt.
Ch.—Filter choke, 30 henry.
R. F. C.—Radio-frequency choke, 10 mh.
Miscellaneous—Chassis, cabinet, speaker, two dials, three sockets, antenna-ground binding-post assembly, set of six-prong plug-in coils, wire, solder, lugs, etc.

Stunt Men Risk Their Lives for Thrills

(Continued from page 23)

Prices vary because bump men compete for jobs, while the more experienced experts look on themselves as professional men who should receive adequate compensation for the grave risks they take.

Several men offered to crash a series of cars for a recent picture, but the studio finally called husky Matt Gilman to wreck nine new sedans in a series of nerve-tingling crashes. No chance to rehearse or shoot retakes—unless the studio wanted to pay for a new automobile each time. During six days of shooting, Gilman drove one car directly in front of a five-ton truck; shoved another through a garage door while the roof caved in on him; telescoped the third against an embankment at the blind end of a street; crashed the fourth into a stack of cases filled with canned goods, and ran another through a drug-store window. The next four he just "tore up," in a series of collisions with other cars. His only protection from flying glass and splinters lay in a wire-mesh windshield, invisible to the cameras, and a strap beside the seat, which he held to avoid being tossed out of the car.

ONLY one car, the one sacrificed to the truck, was specially prepared. With an acetylene torch, the entire rear end, excepting the driving mechanism, was cut through immediately behind the rear seat. Yet, when Gilman was struck by the truck, the back end failed to come off. Instead, the front door flew open and the stunt man found himself on the fender, wedged in between the two vehicles. Only a heavy foot on the truck's brake pedal saved him from being crushed to death.

The public suspects that many of these scenes are mere tricks—that dummies, not flesh-and-blood humans, perform the nerve tinglers. Yet in one recent picture, Rose not only planned the stunts and directed six other experienced stunt men, but performed as well. Protected only by knee pads and flesh-colored gloves, he jumped through a glass skylight, swung across a room on a chandelier which he caught to break the fall, and landed on the floor thirty feet below; rolled down a twenty-foot stairway; drove an automobile into a cast-iron lamp post, through a plate-glass window, and against a building; fought with Green atop a jail, only to knock him off into the rear seat of an automoble thirty feet below, and jumped from the apex of a high roof into a tiny net fifty feet below as flames burned the supports away.

From a spectator's viewpoint, the fire jump is quite thrilling. In fact, it is one of the most dangerous undertakings of the movie daredevils. Speed usually saves a stunt man when plunging through a glass window, the only danger coming from the possibility of glass splinters reaching the floor ahead of him and sticking on end, with sharp points projecting upward ready to impale the jumper as he lands.

BUT fire! No stunt man likes flames. The other day, Rose stood on the top of a tall, flaming set while Green swung across a gap on a rope in a pretended effort to snatch him from the burning building. Green was supposed to miss, while Rose disappeared into the heart of the fire. Old film helped build up intense heat. Rose watched the flames closely. Timbers started to sag. Below, nearly hidden under the beams, he could see sparks floating down onto the life net. Soon he must jump. The roof moved slightly. The stunt man gave the signal for action, and Green came across, dangling by one hand from the rope. Rose missed his outstretched fingers, jumped backward—and thanked his lucky stars he had taken the precaution to soak the life net with water.

Which stunt is the most dangerous? No stunt man can answer the question, for each has his own pet nightmare. Practically all their exploits are spectacular when viewed on the screen. Some are comparatively easy and relatively safe. Some bring more pain than the stunt men like to admit.

Many stunt men "burn out"—some literally. An African tree hut had been built atop a forty-foot pole on a cliff near Balboa, Calif., eighty-five feet above the pounding breakers, for several equatorial scenes. "Natives" chased Rose through the underbrush of the movie forest, and he climbed the pole to seek refuge from their spears.

As he neared the top, his pursuers touched torches to the grass and bamboo shacks. The pole had been planted too far back from the ocean's edge to permit a jump into the sea, so it had to be pulled over. For this purpose, a

Float Won't Upset

ROCKING the boat is made a safe pastime by this new water-sports device. Weights and stabilizing floats make it impossible to bring the saddlelike seat, on its high metal frame, down to the level of the water.

• • •

piano wire, invisible to the cameras, had been run out to a boat, located outside the camera angle.

Meantime, instead of spreading gradually, the flames suddenly burst through the bamboo and licked halfway up the pole. The actor was being suffocated. The pilot of the boat, seeing his plight, started his little craft so suddenly that the wire parted.

The stunt man couldn't climb down through the fire. He tried rocking the pole, hoping it would break at the base. Cameramen remained calm at their posts, grinding on the death scene. They knew there'd be no second chance at this.

Burying his face in his arms, Rose peered downward through the flames. Below, he saw a narrow channel which the sea had cut through the rocks. As a wave rushed in, water covered the hard bottom of the ribbon-like gorge. After ten minutes the pole toppled, falling toward the rocks. Rose leaped sideways as a breaker rolled in, and a ten-foot wall of water cushioned the stunt man's body against the impact that seemed inevitable. The next wave tossed him like a splinter against the rocks. He was rescued a few minutes later, nearly dead.

IN A recent drama of the West, a cowboy star climbed an oil derrick, pretending to look for bandits in the surrounding country. An explosion was supposed to topple the tall structure into a house near-by. It fell to Gilman's lot to ride the derrick down. When it had fallen half way to earth, Gilman pulled himself over the small superstructure rising above the platform and leaped feet-first through a six-foot hole previously cut through the shingles of the roof and onto a net, while the derrick crashed loudly through the porch. Later, the star himself was shown hanging by his fingers from a beam inside the room, while carpenters showered splintered wood on him from above.

The stunt men usually work by twos. One skilled pair found themselves on the roof of a movie jail the other afternoon, each doubling for an actor of his own stature and weight. Costumed as a police officer, the lighter man fought with the "heavy" from one end of the sloping metal roof to the other, finally forcing him to loosen his grip on a weakening gutter by beating on his knuckles with an automatic pistol—made of rubber. The victim fell into a net forty feet below, landing easily on his back.

Some scenes do not permit the use of nets to break falls. On such occasions, the stunt men must rely upon their own agility or on the eager hands of other trained stunt men to catch them. Yackima Canutt fell thirty feet from a burning building and landed on the heads of a crowd, and hardly mussed his hair. On another occasion, a performer came within an ace of meeting death when he fell less than four feet into a crowd.

Instructed to fall over the infield fence from his mount during a movie horse race, he ordered the crowd to stand ten feet back. After placing five layers of green matting, resembling grass, on the ground, he started the race, galloped around the curve, and raised himself in the saddle for the plunge—only to see that the onlookers had moved up to the railing. Too far off his speeding horse to regain his seat, he catapulted headfirst into the mass of men and women. Fifteen extras were crowded into ambulances as a result of that plunge, but the stunt man escaped with bruised ribs.

THESE unsung performers do not look on a fall from a horse as offering any considerable threat to the soundness of their health, unless it is taken over water. More than one has suffered the agony of falling under a struggling horse after a long drop from a cliff into a pond or lake. The only way to escape the thrashing hooves is by swimming under water.

Cliff Lyons sat astride a farm horse, which the company had purchased the day before for $25, trying to urge him into a sixty-foot leap into a lime quarry at Sonora, Calif., not long ago. For some reason, the animal became skittish and refused to budge. Finally, Lyons walked the horse to the edge of the board chute prepared to fend him off the rocks, when suddenly the animal began to slide, turned a somersault, and threw Lyons from his back. Lyons suddenly found himself diving headfirst toward the water, his feet touching the horse as the animal plummeted down, feet in the air, behind him. The stunt man struck the water and the horse struck him. Result: a sprained back for Lyons, and surprise but no injury for the horse.

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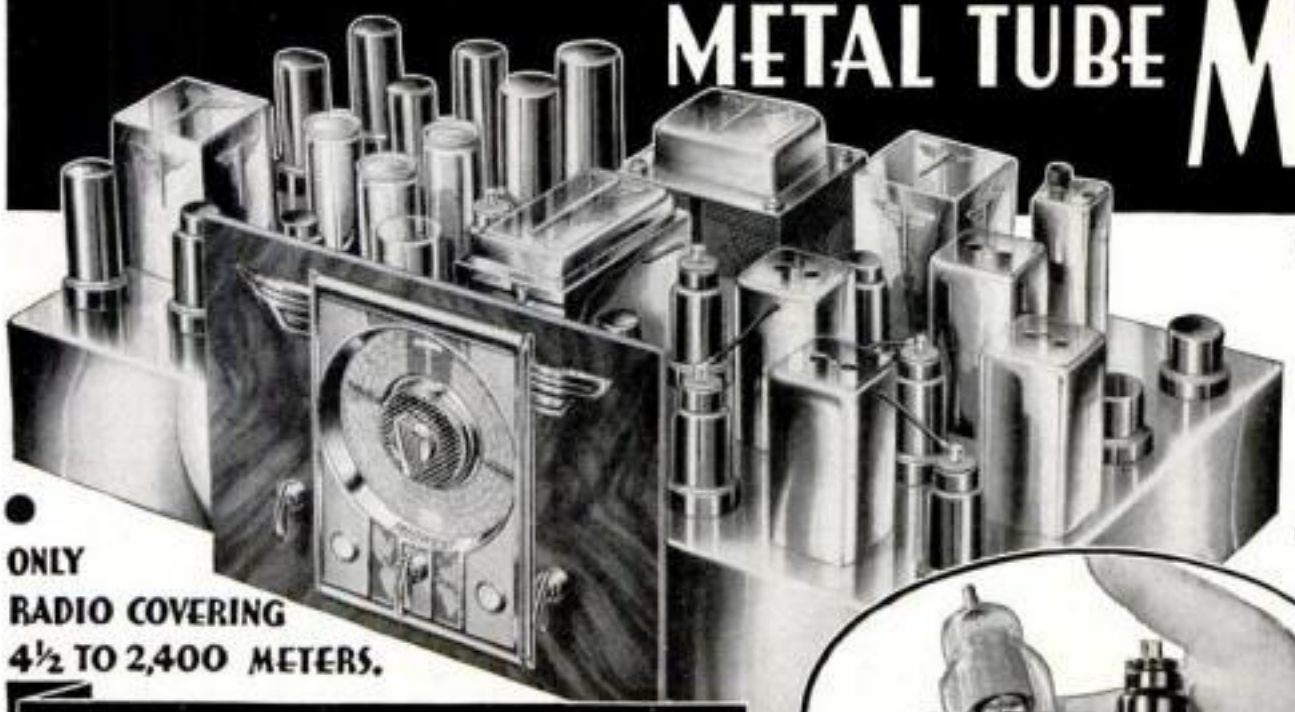

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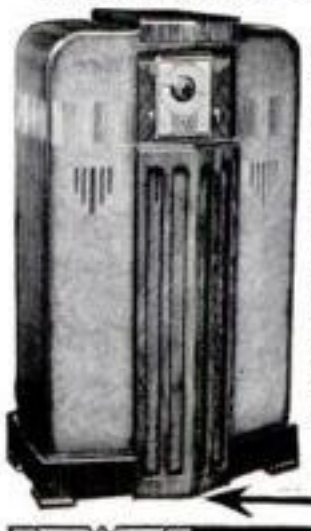

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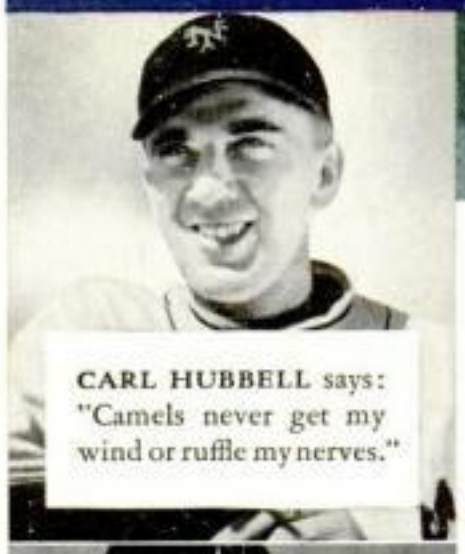
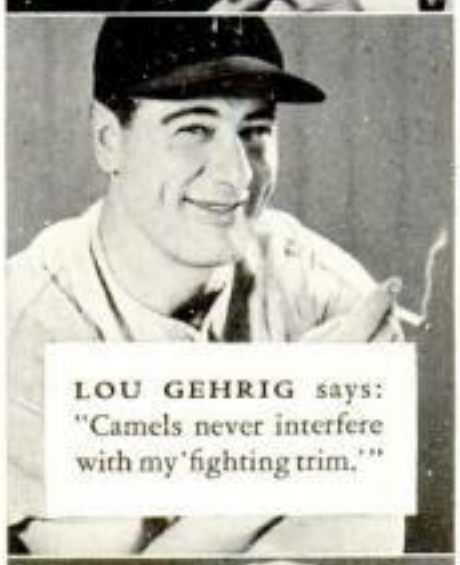
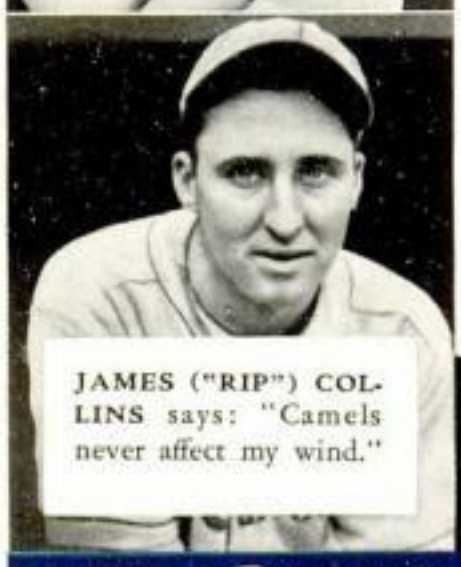


CARL HUBBELL says: "Camels never get my wind or ruffle my nerves."



LOU GEHRIG says: "Camels never interfere with my 'fighting trim.'"



JAMES ("RIP") COLLINS says: "Camels never affect my wind."

Some of the famous athletes who approve of Camel's mildness

BASEBALL
Dizzy Dean — Lou Gehrig
Melvin Ott — Jimmy Collins
Harold Schumacher
Carl Hubbell

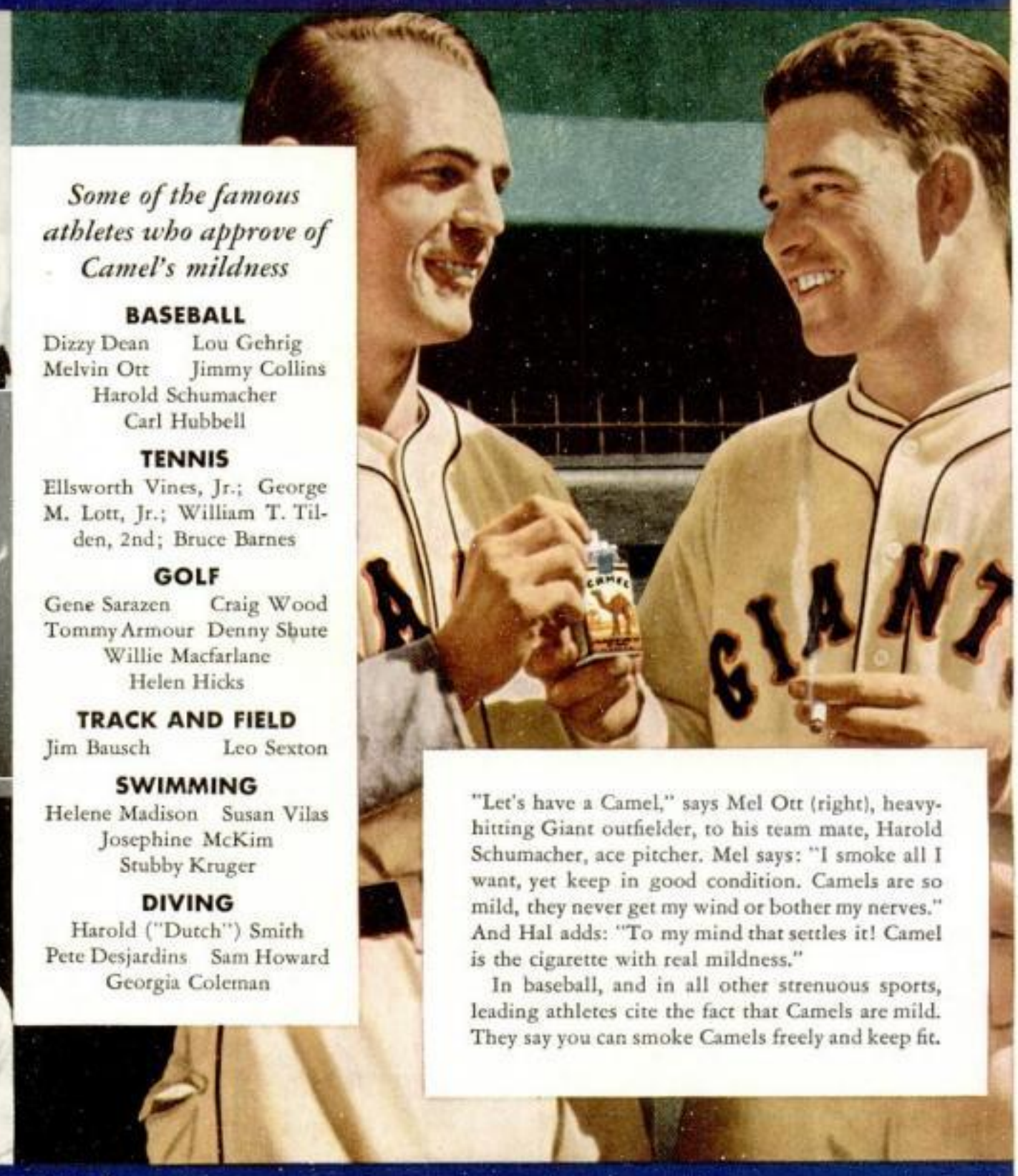
TENNIS
Ellsworth Vines, Jr.; George M. Lott, Jr.; William T. Tilden, 2nd; Bruce Barnes

GOLF
Gene Sarazen — Craig Wood
Tommy Armour — Denny Shute
Willie Macfarlane
Helen Hicks

TRACK AND FIELD
Jim Bausch — Leo Sexton

SWIMMING
Helene Madison — Susan Vilas
Josephine McKim
Stubby Kruger

DIVING
Harold ("Dutch") Smith
Pete Desjardins — Sam Howard
Georgia Coleman



"Let's have a Camel," says Mel Ott (right), heavy-hitting Giant outfielder, to his team mate, Harold Schumacher, ace pitcher. Mel says: "I smoke all I want, yet keep in good condition. Camels are so mild, they never get my wind or bother my nerves." And Hal adds: "To my mind that settles it! Camel is the cigarette with real mildness."

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